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ENGINEERING AND BOILER HOUSE REVIEW

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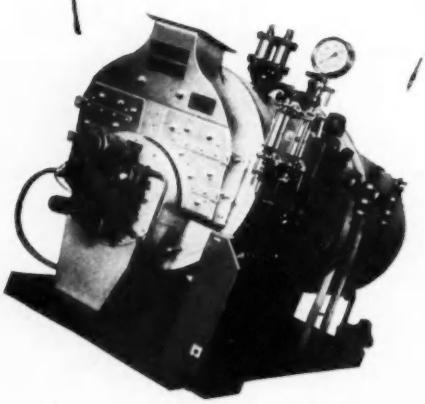

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

NOVEMBER 1961

VOLUME 76. No. 11

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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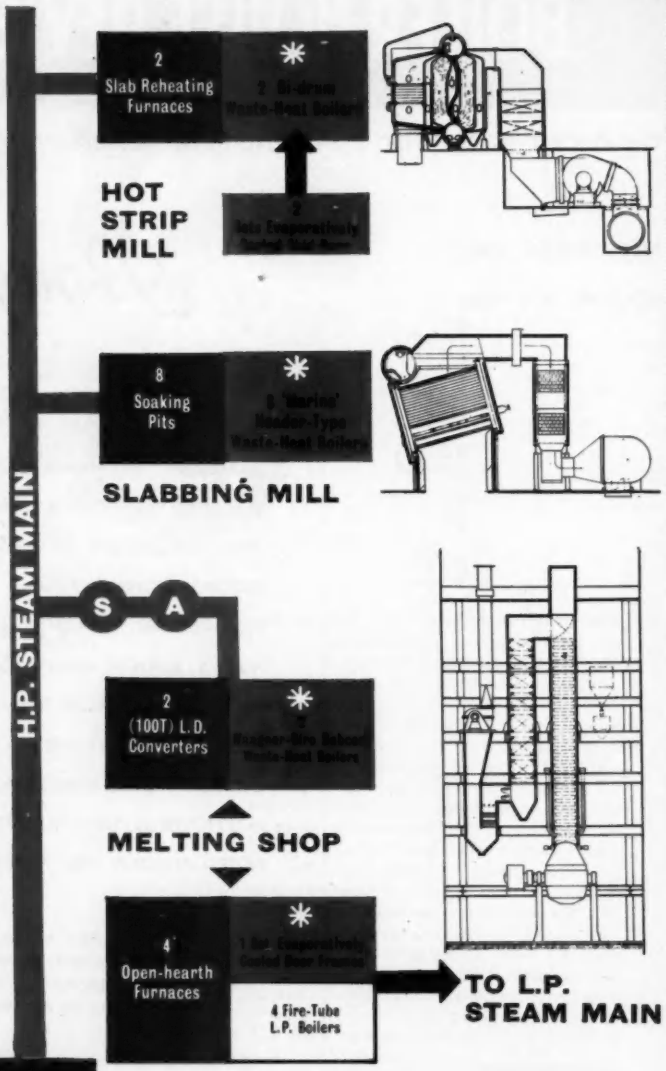

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PROGRESS IN FUEL EFFICIENCY

ELSEWHERE in this issue we include a review of the Seventh Progress Survey, concerning the year ended March 31st, 1961, of the National Industrial Fuel Efficiency Service. In comparing the present state of affairs with that prevailing when N.I.F.E.S. was established some eight years ago, the survey points out that in spite of the fact that there is now an abundance of fuel, industry in general has, for some considerable time, realised the value of the services offered, and the benefits conferred by N.I.F.E.S. In view of these changed circumstances, the income policy of the organisation has been amended, and the decision made that those using the services given, should be asked to meet the full cost of such services.

By making changes on a more commercial basis it was hoped to reduce the amount of financial support from the fuel industries. In commenting further on the matter, the report shows that income for the year under review amounted to 70 per cent. of the costs compared with 58 per cent. in the previous year. It is also pointed out that there had been a noticeable reduction in technical personnel, largely due to the National Coal Board expanding its technical service facilities. But in spite of this, the smaller staff of N.I.F.E.S. actually achieved a 20 per cent. increase in fee-earning work.

Figures show that during the year concerned, some 11,000 visits were made to works and factories using appreciable amounts of fuel, and fee-earning work was carried out for 1,441 clients, of whom 585 were new, while during the years in which the services had been operating (1954-1961), the total reached 5,669. Furthermore, regular service agreements increased by 11 per cent. to 882. The larger proportion of the work carried out concerned investigations into boiler plant operation, and the report mentions that in seven years 2,871 boilers, consuming about five million tons of fuel per annum, have been tested for operational efficiency, and that the results obtained during the last year confirm that the recommendations made by the service can reduce fuel consumption by about one ton in seven.

Another important point stressed is the practical training sponsored by N.I.F.E.S. In this, the number of members taking the courses for boiler operators showed an encouraging increase from 476 to 647. Details of training and refresher courses are set out, and charts give an overall survey of the various plant items covered by N.I.F.E.S. engineers in the foundry and motor car manufacturing industries, examples of the work carried out being given, and figures quoted for the annual saving in fuel costs, apart from the benefits of increased production in the industries concerned. Specific examples of improvements in drying processes are recorded in the report for the manufacture of bricks and ceramics, textiles and chemical works plant, and also in waste-heat recovery in glass works, steel manufacture and in the brewing industry.

A section of the report is concerned with efforts made to solve problems of smoke, grit and dust in effecting a substantial reduction in atmospheric pollution in conformity with the Clean Air Act.

It is clear from results outlined in the report that the important and useful work of N.I.F.E.S. continues, and it is encouraging to note that the number of participants in the training courses for boiler operatives continues to increase, for it is through the medium of these courses that N.I.F.E.S. will make its still further contribution to an ever further increase in fuel efficiency, and to the reduction of atmospheric pollution.

The new suggestion put forward, whereby a commercial charge is made for the services of N.I.F.E.S. engineers, is surely not unreasonable, when it is realised that the average saving in fuel of something like one ton in seven represents a financial gain worthy of the payment of a commensurate fee. Such a fee would relieve the nationalised industries of certain charges, and thus indirectly the taxpayer.

In these days, any contribution to the reduction of manufacturing costs in industry is important. It has been shown that one way of accomplishing this is by the investigation of fuel consumption, an investigation which N.I.F.E.S. has shown can lead to far reaching economies in various ways.

Points and Pointers

BRITISH POWER NEEDS—AND THE EXPORT TRADE

In his address to the B.E.A.M.A. Golden Jubilee Export Conference on "Engineering Achievements in the Electrical Industry," Mr. F. H. S. Brown, deputy chairman of the Central Electricity Generating Board, suggested that the considerable difference in scale between the operations of his Board and those of optional overseas customers should not militate against British manufacturers in the export field. Referring to the tremendous technical developments which had taken place in recent years, Mr. Brown said that teamwork between the electricity supply industry and the electrical manufacturers was producing this "industrial miracle." The growth in size of generating units was not always realised. In the nuclear power field, Calder Hall and Chapelcross had reactors each producing about 37-MW of electricity. This compared with 290-MW at Sizewell—an extrapolation of some 700 per cent. already, and some manufacturers wished to go even bigger. In the orthodox field of power generation, design had advanced from the standard 30-MW and 60-MW sets in stages up to 500-MW units, and thermal efficiencies had thereby increased from 27.6 per cent. up to nearly 40 per cent. Mr. Brown pointed out that the salient factor which had led to these developments at home was the continuing increase in the demand for electricity, and the resultant increase in the size of the distribution system. Both these factors applied overseas, and the only difference was one of degree; but since the Board operated by far the largest fully-integrated single system in the world, the difference in degree was considerable. The overseas buyer of generators, recognising the economies of size, would wish to buy the largest unit he considered rational for his system. For the largest machines, the Board provided both the home market and the operating experience which enabled the British manufacturer to quote. If the buyer required a smaller machine, then the British maker would be able to quote design and operating experience obtained during the evolution of the development to date. Mr. Brown also mentioned the ordering of prototype machines to operate at "super-critical" steam conditions with high thermal efficiency, as an example of how the C.E.G.B. was assisting British manufacturers, though this was not immediately to the Board's "obvious parochial advantage." But if the Board did not take this step, he said, then the makers might have insuperable difficulties in so doing, in consequence of which they might be permanently barred from a potentially attractive world market. Mr. Brown reminded delegates that the most advanced developments were not yet operational and to make them so would need every ounce of skill, knowledge and experience the Board and manufacturer possessed. With a 500-MW unit there was no room for trivial mistakes which could have far reaching consequences. This point was taken up in the discussion which followed Mr. Brown's address, by Mr. E. B. Banks (English Electric Company) who said that if they ran into some trouble with such spectacular developments, this was not itself discreditable to British engineers and British industry.

NEW MEMBERS OF D.S.I.R. RESEARCH COUNCIL

The Minister for Science, Lord Hailsham, has appointed five new members of the Council for Scientific and Industrial Research, and they took office recently. They are Mr. L. H. Bedford, Director of Engineering, Guided Weapons Division, English Electric Aviation Limited, Mr. G. B. R. Feilden, F.R.S., Managing Director, Hawker Siddeley Brush Turbines Limited, Professor E. R. H. Jones, F.R.S., Waynflete Professor of Chemistry, Oxford University, Professor O. A. Saunders, F.R.S., Professor of Mechanical Engineering, Imperial College, London, and Mr. H. C. Tett, Chairman and Managing Director, Esso Petroleum Co. Ltd. Three members who have completed their five-year term of office, retired on September 30th: the former Chairman, Sir Harry Jephcott, Chairman of Glaxo Laboratories Limited, Professor C. E. H. Bawn, F.R.S., Professor of Inorganic and Physical Chemistry, Liverpool University, and Sir Willis Jackson, F.R.S., until recently Director of Research and Education, Associated Electrical Industries Limited, and now Professor of Electrical Engineering at the Imperial College of Science and Technology, South Kensington. A fourth member, Sir Walter Drummond, who was also due to retire on September 30th, has been reappointed for a period of three months. The Research Council at present constitutes 13 members, in addition to the chairman, Sir Harold Roxbee Cox. The secretary is Sir Harry Melville.

TEACHERS IN TECHNICAL COLLEGES

The target figure of 18,600 full-time technical college teachers by 1961, set by a special committee in 1957, has been reached and passed, says a report of the National Advisory Council on the Training and Supply of Teachers, published on October 17th. The report, in a forward look, now estimates that the number of technical college teachers will need to be doubled by the end of this decade. Steps to meet this demand are being examined. Calculating on the basis of observed trends in recent years in the number of students alone, the Council estimates that the present total of technical teachers would need to be increased to about 27,000 by 1963-64, and to about 37,000 by 1970. These figures, the report points out, make no allowance for new developments in technical education. To achieve the 1970 total, the average recruitment rate, allowing for wastage through retirements and other reasons, will need to be stepped-up to some 3,600 annually. The recruitment total for 1959-60 was about 3,000. The report says that it is recognised

that estimates of this kind, extending over a period of years, are bound to contain "a large element of conjecture." The effect of projected expansion in technical education and the consequences of the "bulge" years had to be taken into consideration. The likelihood of a considerable margin of error in the calculations is referred to by the report. A section of the report discusses the supply of teachers in the "shortage" categories, such as graduates in mathematics and science, and various technologies, or those holding advanced qualifications in technological subjects. The report concludes: "The plans for university and technical college expansion give promise of a large rise in the supply of trained manpower during the decade. It is hoped that the estimates of the committee will be taken into account in determining both recruitment policy and the provision of training places in the future." The report "Teachers for Further Education" is published by H.M. Stationery Office price 1s. 3d.

FIVE YEARS OF NUCLEAR PIONEERING

The fifth anniversary of the opening of the world's first industrial-scale nuclear power station—Calder Hall—occurred on October 17th. The experience gained from operating these pioneer reactors—and of the four similar reactors installed more recently at Chapelcross—has been of major importance to the development of nuclear power. Between them, the eight Calder and Chapelcross reactors have aggregated some 24 reactor-years operating experience; and the U.K.A.E.A. reports that extensive investigation has shown no reason to doubt that they will achieve their designed life of 20 years. A total of 5,920 million kW-hr. of electricity have been "exported" to the National Grid, of which 3,729 million are the Calder contribution. The general conclusions to be drawn from the operating experience gained so far, may be summarised as follows: Heat and electrical output have considerably exceeded design expectations; reliability in continuous operation and reduction of fuel-changing and maintenance shut-down periods have been such as to achieve load-factor averaging 88 per cent. of the past year, although all fuel changing has to be carried out with the reactors shut down. This compares favourably with the best capability of the latest coal-fired stations; the magnox-canned uranium Calder fuel elements have successfully withstood periods of irradiation in the reactors far longer than they were designed to achieve, without significant increase in fuel element failure rates. These results have been achieved despite extensive use of the reactors for experimental work on behalf of the larger nuclear power stations now commissioning or under construction.

TENTH COAL SCIENCE LECTURE

The British Coal Utilisation Research Association's tenth science lecture, entitled "The Position of Coal in Electric Power Generation," was delivered at the Conway Hall, London, on October 11th by Mr. L. Rotherham, member for research, Central Electricity Board. The existing position of coal in the generation of electricity is easily indicated by a statement of the relative consumption figures of oil and coal. Coal accounts for about 84 per cent. of all fuel consumed by the Generating Board, but in 1957 the figure was over 95 per cent. and by 1965 it may fall to 80 per cent. Whether the change in the pattern of fuel consumption will differ markedly from the trend indicated by these figures depends on many economic and technical factors which could act either to favour coal or against it. The changes in the electrical load demand in England and Wales are fairly clear. There is the steady increase in load and maximum demand, which, at the present time, varies only slightly from the historical trend of a 7 per cent. increase in maximum demand. The number of units sold increases at a faster rate as the load factor improves, but the distribution of load in different areas of the country remains much as before. If anything, the consumption in areas adjacent to London and the South Coast tends to increase at a rather higher rate than in the Northern Areas adjacent to the coalfields. It is in these Southern Areas and also in the high coal cost area in the North-Western region of the Generating Board that oil has already made inroads into the position of coal as the dominant fuel for power generation. One fundamental reason for this is that oil is more readily transported than coal, and research on fuel transport could help coal to regain its position. Oil will continue to be a strong competitor for coal in that it also has a lower impurity content and is more readily handled. This leads to lower capital costs for oil-burning stations which must be offset by a difference in the basic price of the fuel. Additionally, the solid waste from coal-burning stations must be disposed of at a minimum cost and preferably for some useful application. Apart from oil, coal must face the competition of nuclear energy. So far, the early predictions of the fall in capital cost of nuclear stations have been justified and although at present they are uneconomical compared with coal-fired stations, it seems inevitable that the total costs of generation will move in favour of nuclear energy and it will take up some increasing part of the lead. However, the date when nuclear energy becomes truly competitive has been pushed back by several years, not because predictions on the nuclear side were wrong, but because on the Coal Board side, the rise in the price of coal has been less than had been assumed, whereas on the generating side thermal efficiency has been progressively improved while capital costs have fallen. Progress in the development of conventional plant has been more rapid than had been assumed in the early days of nuclear energy, and if this can be maintained, the date of the large-scale installation of economic nuclear power might be still further delayed. The cost of fossil fuel power stations has fallen and the thermal efficiency at the same time has risen at a rate greater than had been anticipated only a few years ago. It is sometimes overlooked that increases in thermal efficiency require the use of more sophisticated designs and more expensive materials, and the extent to which the marginal increases in capital costs implied by this are justified, depends on the cost of fuel. Work on direct generation devices such as the fuel cell, thermionic and, more particularly magnetohydrodynamic generators is best regarded as a means of improving thermal efficiency and that it is not inconceivable that efficiencies in excess of 50 per cent. might be achieved. Some of these more advanced methods might be easier to devise using refined fuels, but the National Coal Board might well wish to help in the development of coal-fired direct generation devices. Coal has an assured place in the generation of electric power at the present time, but what its position will be in 20 years is not yet clear.

Drakelow 'B'

DRAKELOW "B" generating station, which was formally opened on October 20th by Col. Sir Ian Walker-Okeover, Bt., D.S.O., T.D., Lord Lieutenant of the County of Derby, has an installed generating capacity of 480-MW. The station is situated adjacent to the "A" station of 240-MW installed capacity, and which was described in the December, 1955, issue of ENGINEERING AND BOILER HOUSE REVIEW.

The selection of the Drakelow site of some 1,012 acres, and which is situated approximately three miles south of Burton-on-Trent, was originally made jointly by the former Central Electricity Board, the Corporation of Birmingham and the Corporation of Burton-on-Trent. The construction of a power station at Drakelow was originally envisaged by the Birmingham Corporation Electricity Department, and when nationalisation of the electrical supply industry took place in April, 1948, the plans for the station were already well advanced, and were implemented for engineering constructional purposes by the Midlands Division of the then Central Electricity Board.

The first stage of the site development was commenced in May, 1950, and completed in November, 1955, when the fourth generating unit in the "A" station was commissioned. The site is bounded on the west by the River Trent, which provides a good supply of cooling water; it adjoins the South Derbyshire coal-fields and is relatively close to the Leicestershire and Nottinghamshire coal-producing areas, with which there are good railway connections, in that the Burton to Leicester railway line passes along the north side of the station.

The "A" station, comprising four 60-MW turbo-alternator sets, and four 515,000 lb./hr. unit boilers and associated plant, was designed and constructed with many works which would also serve the "B" station. These works include the reception sidings for the coal trains, water-treatment plant and the river intake works; the control room, welfare facilities and the administration building. Stores and workshops were sited centrally between the two proposed stations so as to be convenient to both. The "B" station houses generating units, Nos. 5 to 8, each of 120-MW capacity, and with the commissioning of No. 8 unit in December, 1960, the second stage of development was reached.

The "B" station being in line with the "A" station and sharing the common administration buildings, was designed to harmonise with the earlier station in its layout, cladding and other architectural features. The third stage of the development commenced during May, 1960, with the preliminary works for the "C" station. This station will house two units, each of 350-MW capacity and two units, each of 375-MW capacity. Thus, with the completion of the "C" station, the total site installation will have a total installed generating capacity of about 2,170-MW.

The geological nature of the site with marl at a convenient level, was favourable to the use of solid foundations. The boiler house—578 ft. long × 90 ft. wide and 146 ft. high—is of solid framed construction with brick cladding and a pre-cast concrete roof. An extension some 32 ft. wide and 67 ft. high, houses the air-heaters and the forced-draught fans. The turbine house, con-

structed with reinforced-concrete frames, with brick cladding and having a pre-cast concrete roof, is 737 ft. long × 70 ft. wide and 90 ft. 6 in. high. In the turbine house a 150-ton lifting capacity overhead travelling crane, manufactured by Sir William Arrol & Co. Ltd., has been installed, together with an auxiliary crane of 25-ton capacity, supplied by The Vaughan Crane Co. Ltd., who also supplied a 16-ton capacity crane for the feed-pump bay.

An auxiliaries bay between the turbine house and the boiler house, 730 ft. long, 55 ft. wide and 66 ft. high, houses the feed-pumps, evaporators, air-compressors and other ancillary plant. To the rear of the boiler house extension are the electrostatic precipitators, the induced-draught fans and the two brick chimneys, each of which is 330 ft. high on a reinforced-concrete stool 70 ft. in height—thus giving a total chimney height of 400 ft. The diameter at the chimney exit is 19 ft. 6 in. The chimneys were built by D. Theaker & Co. Ltd.

The original "A" station was able to be operated for several years after its inception with cooling-water from the River Trent, used on a "once-through" basis—its one cooling tower only being put to occasional use. But the advent of the "B" station construction necessitated the building of three additional cooling-towers to keep river draw-off within the statutory maximum. The "C" station's circulating-water system will be a complete closed-circuit with towers of a capacity adequate to deal with all cooling requirements. River water will be used only for initial filling, and thereafter for "topping-up" compensation for evaporation losses and periodic anti-fouling system washing.

Three of the four cooling towers were built by Davenport Engineering Co. Ltd., each tower being 307 ft. high with a base diameter of 233 ft., a throat diameter of 137 ft. and a top diameter of 146 ft. The towers are of ferro-concrete construction on part-piled foundations and with timber slats. Each tower has a normal capacity of 3,820,000 gal./hr. of cooling-water through a 17 deg. F. range.

The administration block, housing the main control room and administration offices, serves both "A" and "B" stations and is situated between them, the maintenance workshops and stores being to the rear of this building. Since both stations are operated under the one administration, and also make common use of some of the installed facilities, the generating units for the "B" station are numbered 5, 6, 7 and 8 respectively, following in sequence after the four 60-MW units (Nos. 1 to 4) in the "A" station.

Coal-handling plant

The daily coal consumption of the four boilers averages approximately 5,600 tons, the coal being "slack" with a small percentage of slurry. The calorific value is within the limits of 7,500-11,000 B.Th.U./lb. Main deliveries of coal to the station are by rail and on arrival, are dealt with by three side-discharge wagon tipplers designed to handle wagons of up to 24½ tons capacity. The tipplers are provided with weighing facilities, in each case of 500 tons capacity. The wagon tipplers were made by Mitchell Engineering Limited who also supplied the wagon-handling plant. The three tipplers and the wagon-handling plant are controlled from rooms above the tipplers. From the tipplers coal can be taken direct by belt conveyor at a rate of 1,000 tons/hr. to the four 1,300 ton capacity boiler bunkers, where it is discharged by travelling trippers, or to store, where a travelling wing tripper operates on a conveyor running the full length of the coal storage area. Spreading on store is carried out by mobile coal-moving equipment, which includes two tractor shovels with 5 and 8 cu. yd. capacity buckets respectively, and a bulldozer.

The drive units for each of the Mitchell Engineering wagon haulages comprise squirrel-cage motors, Vulcan-Sinclair fluid couplings of the traction type, and reduction gears. The three units for the incoming track haulages for size-23 fluid couplings, transmitting 40 h.p. at 735 r.p.m., the three for the placer tracks size 16.25 of 7½ h.p. and the three for the outgoing tracks 25 h.p. For the three Mitchell wagon-tipplers the s.c. motors are rated at 100 h.p. at 720 r.p.m., and drive-through size-29 traction-type fluid couplings. Each tippler can handle 24 wagons an hour, the fluid coupling being in operation for 41 seconds, and stationary for 110 seconds in each cycle.

For the combined coal-handling plant conveyor-drives for the "A" and "B" stations, a considerable number of Vulcan-Sinclair fluid couplings of the traction-type have been provided, in each case the s.c. motors operate at 720 r.p.m. These fluid couplings range in size from 14.5 to 20, with horse-powers ranging from 5 to 25.

The coal-handling plant for the "B" station was supplied by International Combustion Products Limited. It includes 26 belt-conveyors utilising more than two miles of conveyor belting. Each conveyor has a capacity of 500 tons/hr. The plant is so arranged that the bunkers for boilers Nos. 5 and 6 can be fed consecutively (as can the bunkers for boilers 7 and 8), and so that both pairs can be fed simultaneously. Facilities are also available for feeding both sides of the station from the storage area, and here again, the boilers on each side can be fed simultaneously. In addition, the plant is linked with the "A" station coal-handling plant so that coal can be fed to that station in an emergency. Coal from the tippler hoppers is fed on to the belt conveyors at a controlled rate by Syntron feeders (two F55 feeders each of 250 ton per hr. capacity, situated below each hopper), and from there the route of the coal is determined by the position of flap valves at the various transfer points. The feed to the boiler bunkers is by means of fully-automatic belt trippers which traverse the full length of the bunkers and can be restricted to feed any one compartment by adjusting reversing stops.

The coal storage plant includes a 855 ft. long reversible conveyor which can be used for either stocking-out or reclaiming coal. Stocking-out is performed by a travelling wing tripper mounted on buckets and running on rail tracks. This puts out a continuous pile on either side of the main conveyor, and the coal is then dispatched over the storage area by means of mobile equipment. Facilities have been provided for wagon coal en route to the bunkers. Railborne coal is weighed on the tipple table, wagons being weighed immediately before and after tippling, and the results tape-recorded.

Coal from storage is weighed by means of belt weighers, one being installed on either side of the station. These automatically record and totalise coal passing over the conveyor. Magnetic supporters for removing tramp iron are installed on two of the conveyors feeding the Inter-

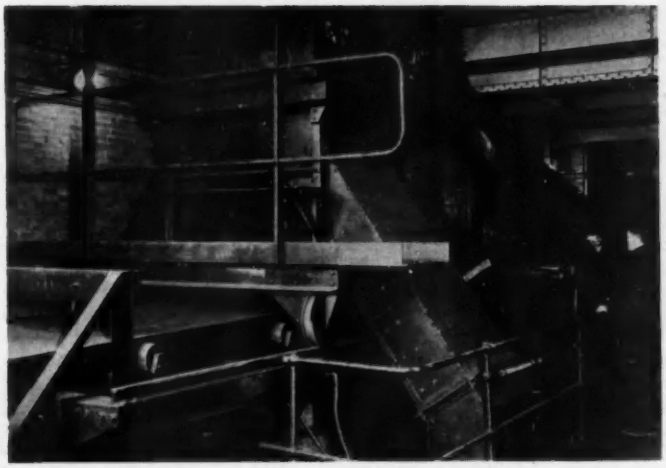
national Combustion boiler (No. 5) whilst four Pollock samplers are fitted to give coal-sampling facilities.

Boiler plant (No. 5 boiler)

The boiler unit associated with No. 5 set was designed and supplied by International Combustion Limited. It has a maximum continuous evaporative capacity of 860,000 lb./hr. when supplied with feedwater at a temperature of 435 deg. F. at the economiser inlet. Steam conditions at the superheater outlet are 1,600 lb./sq. in. and 1,010 deg. F. The single-stage reheat cycle is used, the steam being reheated to 1,005 deg. F. after expansion through the turbine H.P. cylinder.

The boiler is of single drum design, the furnace being arranged for p.f. corner firing. The combustion chamber is completely water-cooled by finned tubes on all sides and roof. Gases leave the furnace through a specially-designed exit channel which screens the high-temperature section of the superheater from direct radiation from the combustion zone. In order to attain the high final steam temperature, no water-cooled screen is provided between the front and rear walls before the superheater. The MeLeSco superheater, supplied by the Superheater Co. Ltd. is built up in four stages—the primary superheater is in two stages and is self-draining, whilst the secondary superheater, also in two stages, is of the pendant-type. The two reheater banks are arranged between the two low-temperature and two high-temperature superheater banks. Control of the main and reheater steam temperatures is maintained by tilting burners, gas recirculation and spray desuperheaters. After leaving the boiler proper, the gas is divided into two parallel and identical steams, each circuit containing an economiser, high and low temperature air-heaters, mechanical dust-collectors, electrostatic precipitators and an induced-draught fan.

The two electrostatic precipitators serving this boiler were supplied by Sturtevant Engineering Co. Ltd., the mechanical dust-collectors being supplied by Davidson & Co. Ltd. Considerable economy in space has been achieved by integrating the mechanical collectors with the precipitators into single reinforced-concrete casings; furthermore, the concrete inlet flues which convey the gas and dust to the mechanical collectors effect economies in steel ducting and long term replacements. Since the gases, after partial cleaning by the primary dust-collectors pass immediately to the precipitators, the plant design is such that the best possible gas distribution to the precipitator tubes is obtained. It appears that this is one of the first central power station dust-cleaning plants to adopt a unified installation of this type. The transforming and high-tension rectifying sets are housed in a small building at ground level and located between the precipitators and the boiler house. The rectifiers are of the well-known Sturtevant mechanical type, there being one high-tension set to each precipitator. These sets are interconnected so that one set may be taken out of service for cleaning and maintenance, and the two precipitators can be charged from one set. Remote control and induction equipment is provided on the boiler control panels, thus permitting manual operation from the control room if and when necessary. The combined plant gives an overall efficiency of 99 per cent. when delivering the flue gas under boiler maximum load conditions. The dust burden of the outgoing gas to the chimney is 0.0517 grain/cu. ft. when the basic fuel is being used.



A belt-conveyor tripper, supplied by International Combustion Products Limited, discharging coal to a boiler bunker.

The coal-pulverising plant comprises five Lopulco LM16 mills supplied by International Combustion Limited. Each mill is swept by a Keith Blackman two-stage exhauster fan driven by a 240/70 h.p. 1,470/960 r.p.m. Laurence Scott motor. Full boiler output can be obtained with four mills in service, a fifth being used as a spare unit for use during maintenance periods.

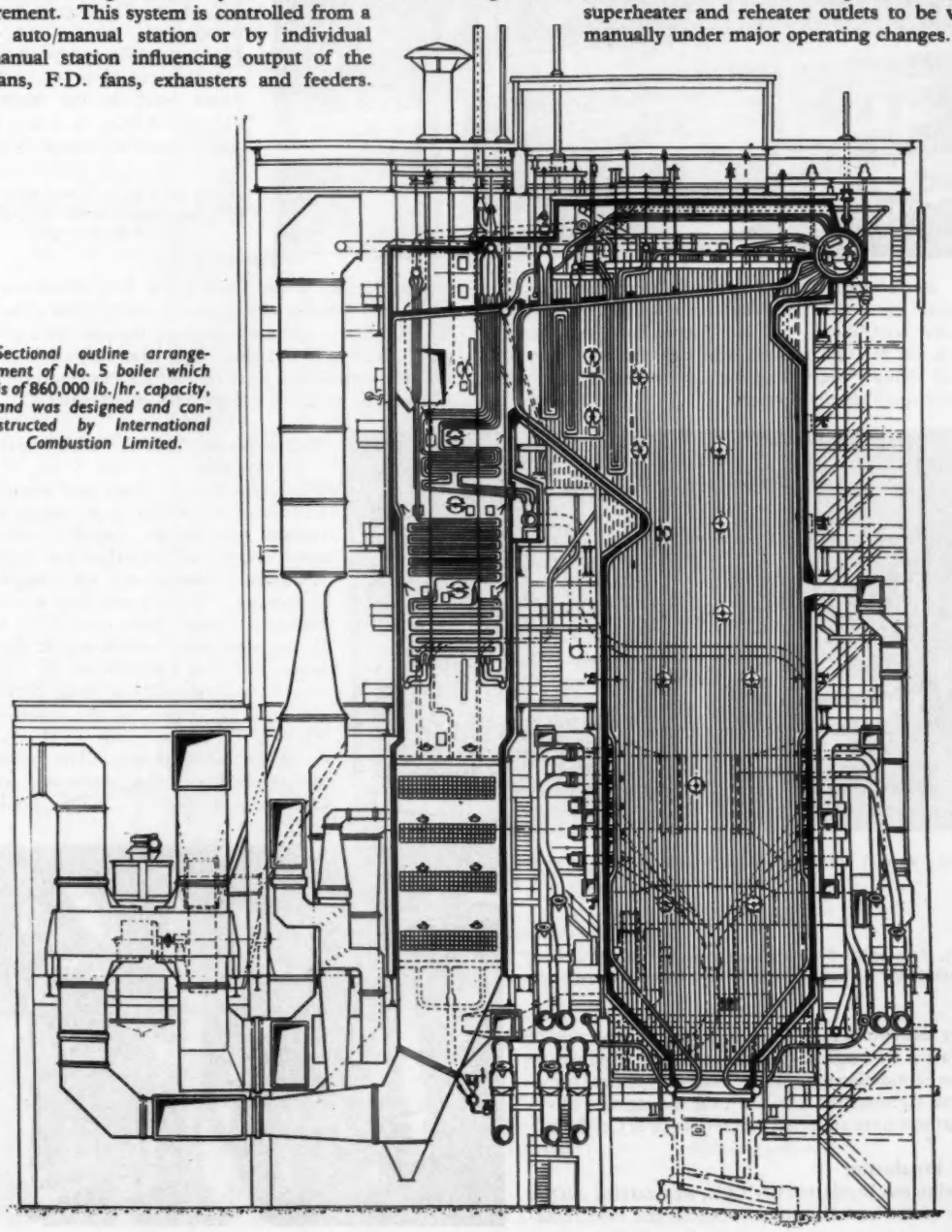
Each mill delivers the fuel to one p.f. burner nozzle in each corner of the combustion chamber, and arranged for tangential firing. Twelve retractable oil-burners are fitted, three at each corner for automatic electric torch ignition. These are supplied with oil at 275 lb./sq. in. and 255 deg. F. by two 11,000 lb./hr. pumping and heating sets, each having 330-kW heaters, from two 70-ton capacity storage tanks. When operating on oil fuel only, the boiler has a steaming capacity of 80,000 lb./hr. The oil fuel burning equipment was supplied by the Wallsend Slipway and Engineering Co. Ltd., and comprises fully-automatic remote control, pulverised fuel igniters. Three banks of four burners are operated by push button electronic sequence timers. The system includes electronic photo cells applied to every burner, and also a self-proving sequence on the ignition torches.

Air for combustion is taken from the top of the boiler house, at 90 deg. F. by two Davidson backward aerofoil bladed, single-inlet, constant-speed, forced-draught fans, driven by 496 h.p., 740 r.p.m., 3.3 kV Laurence Scott motors, each fan delivering 147,000 cu. ft./min. at 10.49 in. w.g., and passed through two size 24½ rotary regenerative air-preheaters supplied by James Howden & Co. Ltd., and having a total heating surface of 216,000 sq. ft. At maximum boiler loading, 1,352,500 lb. of flue gas and 1,142,500 lb. of air are handled per hour;

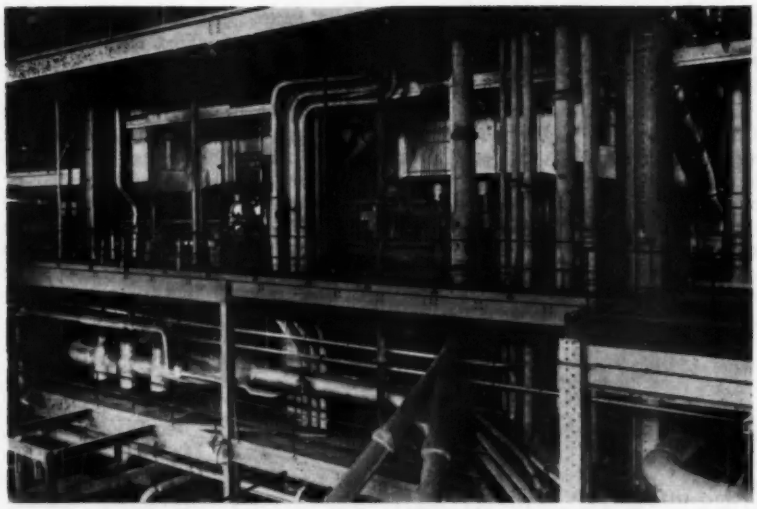
flue gas temperature being reduced from 541 to 264 deg. F. and the air heated from 90 to 403 deg. F. The primary air is taken from the output sides of the air-heaters and passed to the p.f. mills through a further heater of the plate-type to assist coal drying. The secondary air is also taken from the heater output to the p.f. and oil burners.

The combustion primary-air flow through the mill air-heater is controlled by one damper for every five mills, positioned in a duct and pneumatically-operated, the operation being initiated by a common mill suction measurement. This system is controlled from a master auto/manual station or by individual auto/manual station influencing output of the I.D. fans, F.D. fans, exhausters and feeders.

A Lockheed hydraulic damper control system, supplied by Lockheed Precision Products Limited, enables selected isolating and regulating dampers to be operated from the unit control room. A Kent system of superheat and reheat steam temperature control is provided. The superheat and reheat are controlled by temperature recorder controllers to within ± 15 deg. F. initiated by thermocouples in the left- and right-hand superheater and reheater steam pipes. Gas by-pass dampers and gas recirculation fans allow the temperatures at the superheater and reheater outlets to be varied manually under major operating changes. The



Sectional outline arrangement of No. 5 boiler which is of 860,000 lb./hr. capacity, and was designed and constructed by International Combustion Limited.



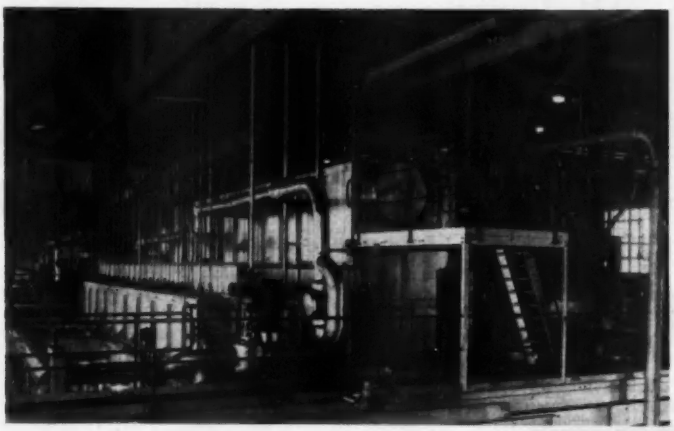
View of No. 5 boiler unit which is equipped with five Lopulco LM16 p.f. mills, each of 14 ton/hr. capacity.

main steam temperature controls are pneumatically-operated from the panel-mounted steam temperature recorder controllers. These incorporate auto/manual stations on the unit control desk adjacent to the remote manual stations controlling the gas by-pass dampers and reheater spray desuperheaters.

The economisers of the gilled-tube type are of 91,392 sq. ft. heating surface, and were supplied by Senior Economisers Limited. For No. 5 boiler (International Combustion Limited), the mountings, valves and fittings were supplied by Dewrance & Co. Ltd.

Heat insulation

Darlington Insulation Co. Ltd., who carried out the whole of the heat insulation work on the four International Combustion boilers in the "A" station, were responsible for the complete heat insulation work on No. 5 boiler in the "B" station. Meta Dextramite high-temperature preformed materials and Darlington 85 per cent. magnesia preformed materials (manufactured by The Chemical and Insulating Co. Ltd.—a member of the Darlington Group of companies), were used. The Darlington Company also carried out the complete thermal insulation work in the main steam piping for Nos. 5, 6 and 7 units (using materials similar to those for the insulation of the boiler), the heat insulation of the evaporator sets for all four units (this including Darlington 85 per cent. magnesia preformed material with planished steel cleading), and they were also responsible for the complete insulation work on all four steam turbines, using Darlington Calcium Silicate preformed material.

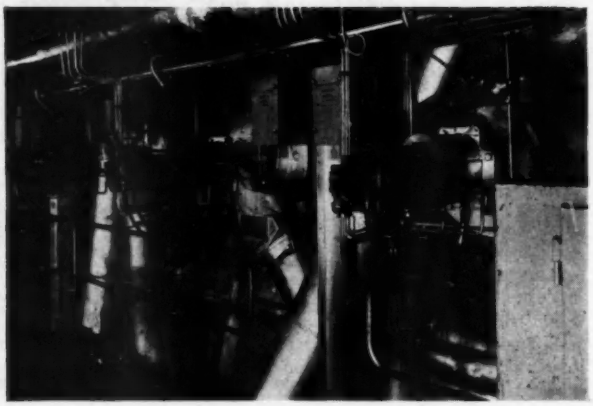


(Above). View at drum level of No. 6 boiler (Foster Wheeler Limited).

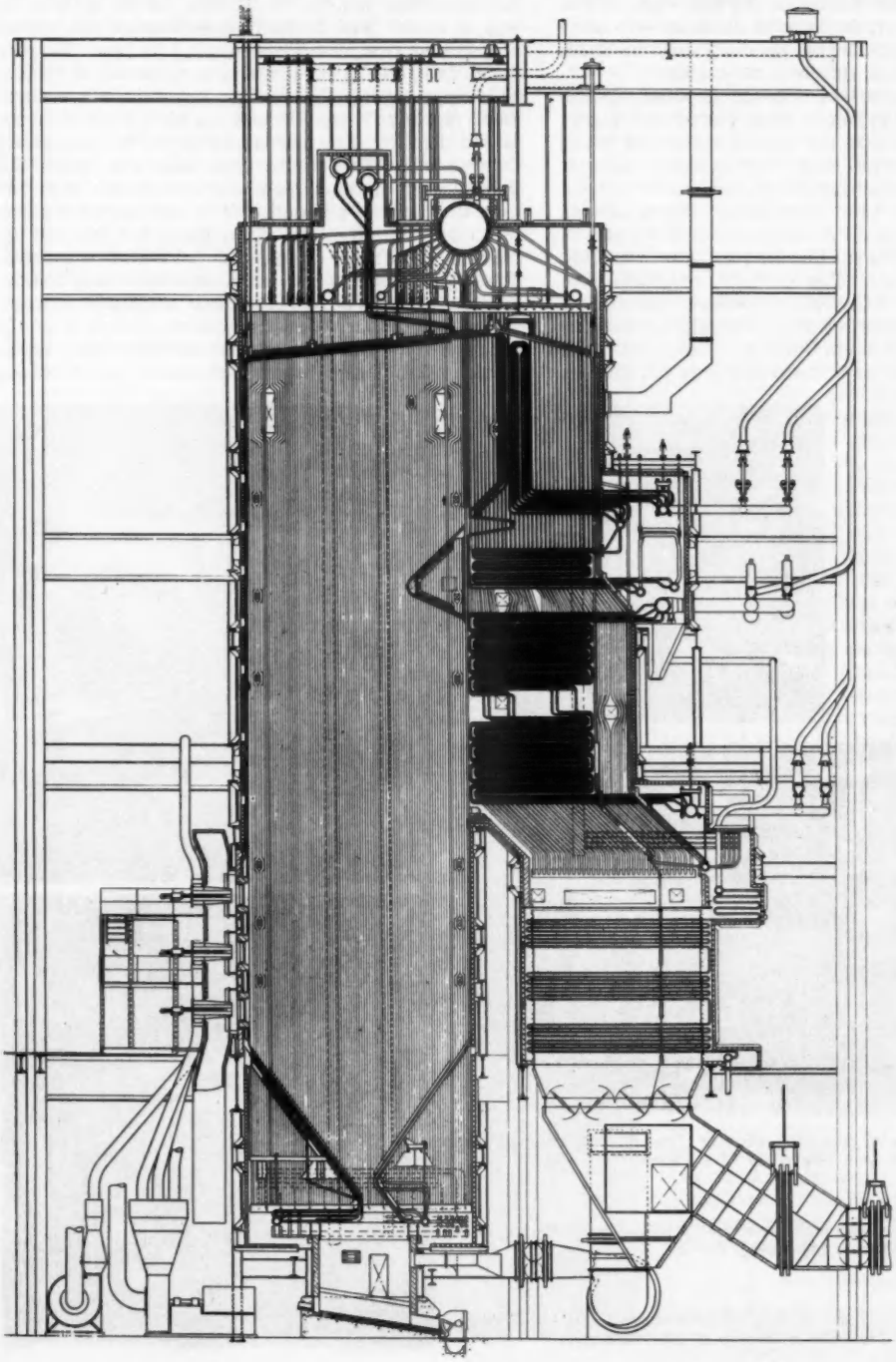
(Right). Front of No. 7 boiler (Foster Wheeler Limited) showing some of the eighteen 27-in. intervane type p.f. burners.

Boiler plant (Nos. 6, 7 and 8 units)

Boilers Nos. 6, 7 and 8 are of Foster Wheeler Limited design and manufacture, and are of the radiant type, having primary radiant superheaters, together with secondary convection superheaters, convection reheaters, economisers and regenerative air-heaters. Each boiler has a maximum continuous evaporative capacity of 860,000 lb./hr. with steam conditions at the superheater outlet of 1,600 lb./sq. in. and 1,010 deg. F., and reheating of steam between the h.p. and i.p. stages of the turbines from 697 deg. F., to 1,005 deg. F. at 425 lb./sq. in. at the reheater inlet. The economisers are supplied with feed-water at a temperature of 443 deg. F. The boilers are



supported from the boiler house roof steelwork, independent means being provided for supporting the drum and furnace rearwall tubes, the superheaters, reheaters, headers and downcomers. The furnace which has a volume of 76,800 cu. ft. is of the twin type lined on the rear walls and sides with water tubes, and provided with a water-cooled divisional wall. The front wall of the furnace forms the radiant superheater, which consists of 2 in. o.d. down-flow and up-flow tubes alternating with one another. The down-flow tubes are connected to upper inlet headers (which function as steam temperature control headers) and line the roof and front wall and

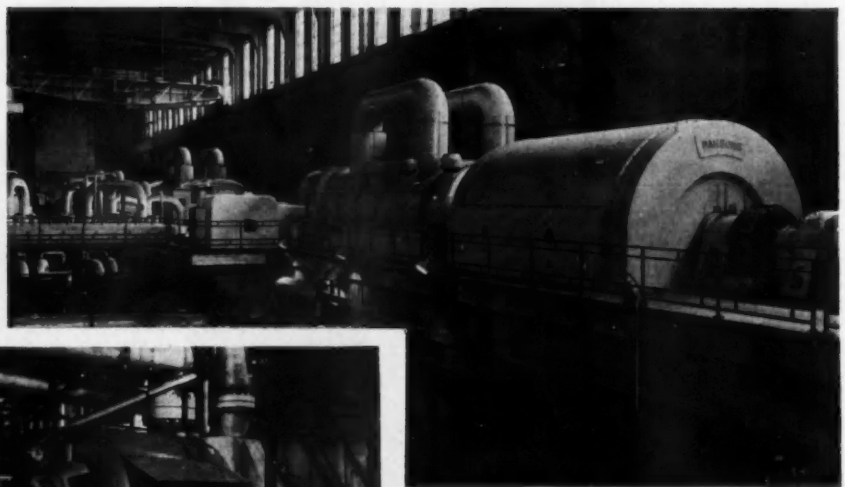


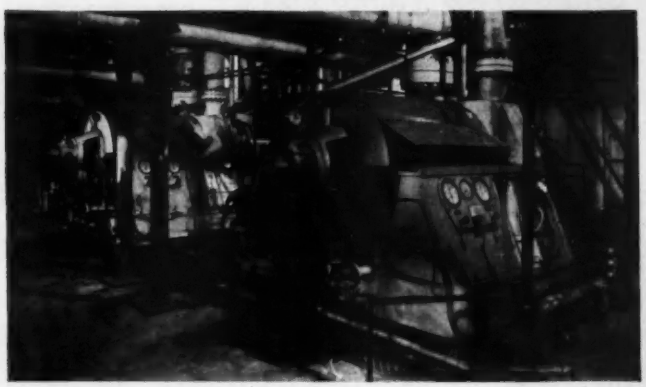
Sectional outline arrangement of one of the boiler units (Nos. 6, 7, and 8) which were supplied by Foster Wheeler Limited. These boilers, of the radiant type, are each of 860,000 lb/hr. maximum continuous evaporative capacity.

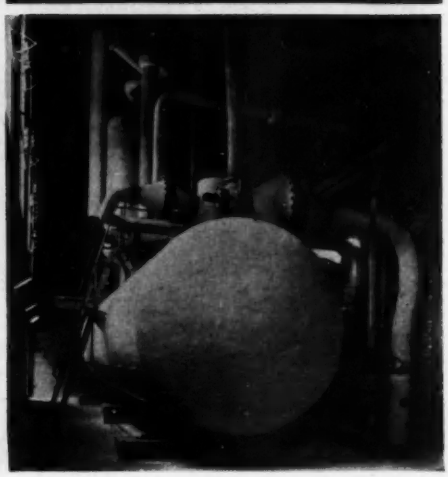
terminate at lower intermediate headers. The up-flow tubes are also connected to these lower headers and alternate with the down-flow tubes to complete the lining of the front wall and roof and then extend partially down the rear wall to the back of the furnace gas outlet pass to the radiant superheater outlet header. This header is connected to the inlet header of the first stage of the convection superheater, the tubes of which are serpentine and lie horizontally in the rear gas-duct, with the steam flowing upwards counter current to the gas flow.

This superheater connects with the secondary section of convection surface in hairpin form, placed immediately behind the slag-screen at the furnace outlet and where the steam receives its final heat. Also situated in the rear gas-pass is a two-stage convection reheater, and a 'Greens' type-15 economiser, both being down stream of the convection superheaters. A damper control by-pass is provided for the reheater, this by-pass duct extending through the economiser. The coal is fed to three Foster Wheeler double-ended ball-mill pulverisers each capable of pulverising 26 tons/hr. of coal. Two Keith Blackman exhauster fans deliver the pulverised coal from each mill to six of the eighteen 27 in. intervane-type p.f. burners mounted on the front wall of each boiler furnace. These burners, which each have a capacity of 4½ tons/hr. of coal, are also fitted with a retractable oil-burner in the centre and provided with a high energy discharge type igniter. The oil is supplied to the burner at a reduced pressure of 10 lb./sq. in. at 240 deg. F., with air for atomisation at 100 lb./sq. in. delivered by a Broom and Wade air-compressor. Each boiler can steam at 30,000 lb./hr. when operating on oil fuel only, this being sufficient for very low load conditions. Air for combustion is supplied by two Davidson forced-draught fans per boiler, with single side inlets, each fan delivering 128,500 cu. ft./min. of air at 8.06 in. w.g. at m.c.r. The air then passes through two size-24 regenerative type air-heaters supplied by James Howden & Co. Ltd., and having a total heating surface of 230,800 sq. ft. per boiler. The flue gas temperature is reduced from 595 to 267 deg. F., and the air heated from 100 to 510 deg. F. The primary air to the burners passes through a further tubular-type heater to assist coal drying when burning high moisture-content fuel, and then through the p.f. mills. The secondary air passes direct from the air-heater to the pulverised-fuel and oil-burners. Each boiler is fitted with two Davidson induced-draught fans with double inlets, each delivering 198,000 cu. ft./min. of gas at 10.73 in w.g. at 223 deg. F. at m.c.r.

The superheater steam temperature control is of the condenser type with tubular heat-exchanger fitted in the primary radiant superheater inlet headers and receiving







(Top). Turbine house interior from alternator end of No. 9 set. Each of the four 120-MW sets were supplied by C. A. Parsons & Co. Ltd.

(Centre). All the booster, and main boiler feed pumps were supplied by The Harland Engineering Co. Ltd.

(Right). De-aerator for No. 7 set. Each of the de-aerators, supplied by William Boby & Co. Ltd., have a capacity of 805,440 lb./hr.

cooling water from the feedwater system which by-passes the economisers. The reheat steam temperature is controlled by dampers in the reheat by-pass duct, regulating the quantity of gas flowing over the reheater with spray-type de-superheaters in the reheat piping for emergency use. Both of these steam temperatures are regulated by Electroflo control systems which are pneumatically operated and maintain the desired temperature to ±15 deg. F.

The boiler valves and mountings, piping valves and turbine valves for Nos. 6, 7 and 8 sets were supplied by Hopkinsons Limited, and comprise torsion bar safety-valves, "Hylif" safety-valves, safety-valve silencers, combined stop and non-return valves, high and low water alarms, water-level television equipment, Hopkinson-Ferranti valves, electric valve controls, "Uniflow" valves, etc. All four boilers are also supplied with Hopkinsons' electrically-operated retractable and long retracting soot-blowers. Soot-blowers on the economisers are of Hopkinsons' half-retractable long-travel type.

Boiler control equipment

All four boilers are equipped with automatic combustion control equipment using an "Electroflo" pneumatic/hydraulic system supplied by Electroflo Meters Co. Ltd., which provides constant control of steam pressure, combustion rate and combustion-chamber pressure. The rate of fuel and air-flow is controlled in a pre-determined ratio, with automatic correction for changes in fuel quality, by the continuous comparison of steam evaporation and the amount of combustion-air used. The installation combines a pneumatic loading-system with hydraulic and pneumatic power cylinders selected to suit individual duties. All measuring regulators are of the force-balance type. The desired steam-pressure is maintained by means of a master controller, connected to the steam mains. It converts the changes in steam pressure, which occur with variation in load, into an air-loading pressure for transmission to the individual regulators controlling the combustion rate. Combustion air is controlled by the air-flow regulator. Inlet vanes of the two FD fans are operated in parallel by two positioning regulators which are loaded from a sender relay in the air-flow measuring regulator, air-flow differential being measured in each of the FD fan inlet-ducts by venturi contractions and pneumatic transmitters. The output from these transmitters is summated and the result applied to the measuring regulator, balanced against the master loading-pressure. The furnace pressure is held constant by the ID fan regulator. Inlet vanes of the two ID fans are operated in parallel by two positioning regulators which are loaded from a sender relay in the measuring regulator. This measuring regulator senses the combustion-chamber pressure, and is independent of the master controller. Fuel quantity is regulated by controlling the primary air-flow to the mills. The master loading-pressure is balanced against the air-flow differential by the primary-air regulators. The mill output-dampers are controlled by positioning regulators which are loaded from a sender relay in the measuring regulator. Mill suction and tempering air controls are also provided. Main steam temperature control is effected by characterising the master loading signal in accordance with the expected load/steam temperature relationship, and correcting this signal for any temperature deviations. Reheat temperature control is achieved by regulation of by-pass gas dampers in relation to reheat temperature measurement.

Control of feedwater flow maintains a constant level of water in the steam drum, by regulation of the feed-water control valve. Two valves are provided, each capable of 100 per cent. duty by positioning regulators. These regulators are loaded from a sender relay in the measuring regulator, which in turn receives pneumatic impulses from steam-flow, feed-flow and drum-level transmitters. Comparison of these impulses is so arranged that feed-flow requirements are anticipated by changes in steam-flow, to maintain constant drum level. The auto/manual sub-panels, provided on the unit control desks, permit the operator to switch the boiler from automatic steam-pressure control to unified manual control, or alternatively, to individual operation of all regulators.

The main steam and re-heat steam pipework for Nos. 5 and 6 boiler/turbine sets was made and supplied by Stewarts and Lloyds Limited, and for Nos. 7 and 8 sets by John Thompson (Pipework) Limited. All this pipework is of 2½ per cent. chromium, 1 per cent. molybdenum steel, with butt-welded joints. Valves are installed on each reheater inlet and outlet to isolate the reheater for hydraulic tests. The left- and right-hand main steam pipes are cross-connected, and similarly the right- and left-hand reheat return piping to the turbines are cross-connected. This arrangement permits on-load test-tripping either of the turbine stop valves or either of the intercepting valves of the reheat lines.

The steam piping for No. 5 boiler/turbine unit was supplied by Stewarts & Lloyds Ltd.

Ash and dust-handling

The ash and dust-handling plant was supplied by John Thompson Industrial Constructions Limited. Ash and clinker from the combustion chambers, collected in dry-ash hoppers beneath each boiler, are disintegrated and ejected by water-jet nozzles and conveyed to the ash sump by further jets in the removable nickel-cast-iron lined sluiceways. Similarly, fines deposited in hoppers underneath the economisers are transferred to the dust sluiceway.

Three 50 per cent. duty sluicing pumps with a capacity of 1,900 gal./min. are provided. The fines, which are removed from the flue ducting by the centrifugal collectors and electrostatic precipitators, drop into storage hoppers. They are then removed by vacuum, induced by hydraulic ejectors, permitting the air-borne solids to mix with the ejector water to form a slurry, which is conveyed to the dust sump by gravity along brick-lined sluiceways. Dust and ash slurries are removed from the respective sumps by three 100 per cent. duty ash pumps and two 100 per cent. duty dust pumps and transferred to disposal sites comprising exhausted gravel pits at Drakelow and Branston. Two 100 per cent. duty grinders are installed. Excess slurry from the ash and dust sumps is taken to an overflow sump from which it is pumped to the ash launder of the " A " station.

Generating plant

The four 120-MW sets, designed and made by C. A. Parsons & Co. Ltd. are arranged longitudinally in the turbine house. The turbines are of the three-cylinder impulse reaction-type with a double-flow l.p. cylinder, and they operate at a speed of 3,000 r.p.m. Each machine has 13 h.p. stages, including a single velocity compounded impulse stage, 19 i.p. stages and 8 l.p. stages in each of the turbines. After passing through the h.p. cylinder, the steam is returned to the boiler for reheating before entering the i.p. cylinder. The main speed governor controls the high-pressure steam admission valves, and an independent auxiliary governor is fitted to regulate the intercepting and unloading valves, an arrangement allowing auxiliary governors to be set independently of the main governor. The main oil pumps consist of three helical gear pumps driven from the main turbine shaft, a lubricating pump supplying oil at a pressure of 20 lb./sq. in. to the main bearings, a power pump discharging oil at 100 lb./sq. in. for operating the steam valves, and a pilot and seal oil pump delivering oil at 70 lb./sq. in. for the operation of the pilot pistons of the main governor valves and supplying the generator hydrogen seals at a pressure reduced subsequently to 25 lb./sq. in. at the seals. An auxiliary pump, driven by an a.c. motor, has three pumps on the same shaft. The power and pilot and seal pumps are of the helical gear type, and a centrifugal pump is used for lubrication. Turbine supervisory equipment has been installed to measure h.p. and i.p. shaft eccentricity, shaft speed, bearing vibration, cylinder expansion, etc. In each case, visual indication and continuous recording facilities have been provided on a local panel, with visual indicators also fitted in the unit control room.

From the double-flow exhaust of the l.p. turbine cylinder and the exhaust outlet from the l.p. turbine, steam passes into a twin-shell, three-flow, surface-type condenser which has a total cooling surface of 85,000 sq. ft. and is designed to give a vacuum of 28.9 in. Hg. when supplied with 58,000 gal./min. of cooling water at 55 deg. F. Two 100 per cent. duty horizontal two-stage a.c. motor-driven extraction pumps, rated at 770,000 lb./hr. at 257 ft. head are used to extract 570,839 lb./hr. of condensate at a temperature of 81 deg. F., while air is removed from the condensers by three 50 per cent. duty Mirrlees Watson pumps, each of 251 lb./hr. capacity. For quick starting, a single Hick Hargreaves air pump is fitted for each unit, capable of producing an absolute pressure not greater than 10 in. Hg. in 5 min. The extraction pumps discharge to an in-line, regenerative feed-heating train, comprising a drain cooler, three l.p. feed-heaters, including a de-aerator, three h.p. bled steam heaters and an evaporator vapour condenser.

Feed pumps

For the four units, the complete boiler feed equipment was supplied by The Harland Engineering Co. Ltd. One feeder, one stand-by with their associated booster pumps are installed for each unit, and all pumps are driven by Harland motors. As the plant arrangement is of unit layout, each unit is a separate entity with no steam or feed interconnections. The booster pumps draw feedwater from the storage tank of a de-aerator at a temperature of 260 deg. F., and deliver it to the main feed pump suction through three high-pressure heaters at a capacity of 965,000 lb./hr. At the feeder suction branch, the temperature is 435 deg. F. and the discharge pressure of the feeder is 1,960 lb./sq. in. The feeders are of Harland " Compensated " design, a high duty type which incorporates built-in protection against the adverse effects of high pressure and thermal differentials. Seven-stage pumps serve No. 5 unit, while eight-stage machines are supplied by Nos. 6, 7 and 8 sets. " Spiroglide " through-bolt-type booster pumps of seven-stages are provided on all units, and the pumping sets are protected against reduced boiler load demand by Hopkinsons' leak-off valves and control equipment. Two-pole squirrel-cage Harland motors drive the feeders at 2,980 r.p.m. from a 3.3 kV supply; the booster drive is by similar four-pole machines with a speed of 1,480 r.p.m. The two sets of motors are rated for continuous operation at 2,700 and 900 b.h.p. respectively.

Circulating-water supply is drawn from the Trent and from the cooling tower ponds by Drysdale pumps, each having a capacity of 62,500 gal./min. against 43.5 ft. head. Water is chlorinated at the circulating-water pump house by automatic intermittent chlorination plant supplied by Wallace & Tiernan Ltd. The de-aerators were supplied by William Boby & Co. Ltd. Each unit is rated for an output of 805,440 lb./hr. at a temperature of 260 deg. F., oxygen content being no greater than 0.007 p.p.m. Each unit comprises a vertical de-aerator pump 9 ft. dia. mounted on a storage tank, 10 ft. dia. × 38 ft. long. All de-aerators were supplied complete with water and steam controls, bled steam, non-return valve, provision for boiler feed pump leak-offs, etc.

Generators

Each of the hydrogen-cooled alternators, generating at 13.8 kV, are rated for continuous operation at 120-MW at 0.9 power factor, with a hydrogen pressure of 15 lb./sq. in., distillate being used in four heat-exchangers for hydrogen cooling. The air-cooled totally-enclosed main and pilot exciters are gear-driven at 750 r.p.m. from the main alternator shaft. The automatic voltage regulator is of the quick-response static type incorporating a magnetic amplifier and a twin amplidyne set. The equipment incorporates a follow-up mechanism which permits a smooth changeover from automatic to manual control. Each alternator is solidly connected to a 13.8/295 kV, 125 MVA, OFW-cooled generator transformer by double-angle section copper busbars on porcelain supports.

Water treatment plant

The water supply to the evaporators is obtained from the Trent, and first treated in a lime soda base-exchange softening plant supplied by John Thompson-Kennicott Limited, and which serves both the "A" and "B" stations. The river water which is not only of a very hard nature, but is a sedimentary water containing many impurities, including ammonia, is delivered to a main chemical reaction sedimentation tank. As the water enters this tank, it automatically receives hydrated lime for the reduction of the temporary hardness, and sodium silicate for flocculation. From the main reaction sedimentation tank, the water is delivered by booster pumps through three rubber-lined pressure-vessels or stabilisers which not only arrest any suspended matter which has not settled in the main sedimentation tank, but produce a stable water. The stabilisers, which are equipped with carbonaceous zeolite, complete the chemical reaction and take up the alkaline hardness so that upon leaving the stabilisers the water contains only the permanent hardness plus from 10 to 15 p.p.m. of alkaline hardness. The base-exchange softeners contain a synthetic resin which is regenerated with salt for the production of zero hardness. The same units are employed for the removal of ammonia from the water, this being achieved by the Kennicott patented method which employs caustic soda as the regenerant. The plant is designed to deal with 20,000 gal./hr. of water.

Each pair of turbo-alternator/boiler units is controlled from a unit control room situated in the auxiliaries bay midway between the pairs of machines and boilers, the necessary instruments and controls for the operation of the units being incorporated in desks and panels situated at turbine operating floor level. The main electrical control room for the 275,132 and 3.3 kV systems of both stations is situated in the administration block and houses the generator load desk for the "A" station, the 275,132 and 3.3 kV control panels, the "A" station river water and "B" station circulating water pump motor control desks, the 275, 132 and 3.3 kV systems alarm relay equipment panels, the automatic voltage regulators for the "A" station and the station generator relay panels and chlorinating programme clock for both stations.

Control room for units Nos. 5 and 6 located midway between the pairs of machines and their associated boilers.

STEAM PLANT FOR YEAST-PRODUCT PROCESSING

English Grain Co. Ltd., and their associates the Trent Yeast Extract Co. Ltd., Burton-on-Trent, have installed new centralised, oil-fired boiler plant with inter-connecting steam mains at their Shobnall Road premises, to replace existing hand-fired solid fuel boilers. Running costs of the old plant kept by the company show that the estimated cost of the fuel-oil system together with its greater efficiency and reduction in labour costs will mean a subsequent saving of about 3s. per 1,000 lb. of steam raised. Based upon the company's high, all-the-year-round demand for steam, the capital outlay of nearly £30,000 for the new installation should be repaid in a reasonably short space of time. The complete boiler house and plant, instrumentation and distributing steam mains, has been designed and installed by A. R. Hancox Limited, of Birmingham. The two new boilers are "Steambloc" Super Economic oil-fired packaged boilers rated at 10,000 lb. steam evaporation per hour (boiler feed water at 212 deg. F.). Firing is on heavy grade 3,500-sec. Redwood No. 1 fuel oil. The fuel oil is stored in an adjacent 6,500 gal. tank and drawn off through a filter and fire valve to serve the boiler burners. Because of its viscosity, the oil in the pipe between tank and boiler is kept at a temperature of 100 deg. F. by means of thermostatically-controlled Pyrotenax electric heating cables. The main oil storage tank is insulated to take advantage of the heat in the oil when delivered; however, to ensure that the oil leaving the tank is at the correct temperature for the burners, a steam/electric outflow heater is fitted, arranged so that the heating is carried out by steam when available, or otherwise by the electric elements. In siting and installing the plant, the existing steam and condensate arrangement was initially surveyed in detail so that the new mains could be interconnected with the minimum interruption. As a high percentage of the steam raised is required for process work of a type where the condensate cannot be re-used, up to 4,000 lb./hr. condensate must be made up with raw water from the town mains. To protect the boilers, water-softening plant has been incorporated. All steam, condensate and condensate tanks are efficiently insulated to prevent unnecessary loss of heat and to keep running costs to the minimum.

A new company, **La Compagnie Continentale D'Equipements Electriques (C.E.E.),** has been formed by **The English Electric Co. Ltd.** and the French firm, **Les Exploitations Electriques et Industrielles,** to carry out the manufacture and sales of all types of electric and electronic control equipment for France and the Common Market countries. The technical experience of the English Electric Group in this field of engineering will be available to the new company whose capital, NF. 5 million, will be held equally by the sponsoring firms. The members of the Board are Mr. Jacques Levy-Rueff, who is also appointed chairman, Mr. Georges Seban, English Electric and Les Exploitations Electriques et Industrielles. Mr. Pierre Bouillot is appointed general manager.

In the article "Progress at Trawsfynydd," published in the August issue of this journal, we omitted to refer to the fact that Dewrance & Co. Ltd. were responsible for the supply of valves for the steam and feed pipelines respectively. The large-bore valves for the main steam line are of the venturi-type parallel slide valves, and depending upon their location, are fitted with extension gear for manual operation, or with actuators of the direct-on type with remote control. A large number of Dewrance forged-steel valves were also supplied.

Electricity Supply in England and Wales

A REVIEW of the electricity supply industry in England and Wales is given in the third annual reports of the Electricity Council, and of the Central Electricity Generating Board, published last month. These notes survey the comments in the reports concerning the technical developments in generation and transmission, progress in research, trading and financial results achieved during the year under review.

At the end of March, 1961, the Central Electricity Generating Board owned 230 power stations. The total maximum output capacity of these stations was 27,067-MW, a total of 1,668-MW of new plant having been installed during the year. Total installed generating capacity has more than doubled in the past ten years; but, as a result of the policy of installing larger sets, it has been possible to reduce the number of power stations by just over 20 per cent., viz. from 290 to 230. Four new steam stations were brought into operation; at Staythorpe "B," Skelton Grange "B," Rugeley, and Uskmouth "B." During the year, the first reactors of the C.E.G.B. nuclear power stations at Berkeley and Bradwell, were substantially completed. Pre-commissioning tests were commenced in preparation for fuel loading (which began in August). At the Hinkley Point nuclear station, the No. 1 reactor pressure-vessel was completed and tested. Good progress continued with the construction of the nuclear power station at Trawsfynydd, and contracts were placed for a 550 MW nuclear station at Dungeness, and for a 580 MW nuclear station at Sizewell. The Minister of Power gave consent for the building of the seventh C.E.G.B. nuclear power station of 550 MW capacity at Oldbury.

Generating plant development

The development of larger high-performance generating units continues, which should lead to further savings, both in capital cost of power stations and plant and in operating costs. During the year, orders were placed for four units of 350-MW (installed capacity) and eight of 500-MW. All have single-shaft turbo-generators, and are being designed for steam conditions of 2,300 lb./sq. in. and 1,050 deg./1,050 deg. F. reheat. These machines are characterised by multiple-flow low-pressure cylinders, for which new methods of support are being developed to ensure freedom from vibration and foundation settlement. Two supercritical units of 375-MW each, with steam conditions of 3,500 lb./sq. in., 1,100 deg. F., reheating to 1,050 deg. F. were ordered during the year.

Operating experience

Advances in the size and steam conditions of generating units in coal-fired generating stations, and consequently in thermal efficiency, are shown in the accompanying table of the most advanced designs, commissioned or due to be commissioned in the years shown.

The prototype water-cooled stator windings at Bold "A" and Tilbury gave satisfactory service, and all the generators ordered in the last year will have stator cooling of this type with the rotors directly cooled by hydrogen, except for the Dungeness machines where the rating of the generators does not justify the use of direct water-cooling. Rectifier excitation has been developed satisfactorily, and all large generators will in future have a.c. exciters directly driven from the main shafts, used in conjunction with air-cooled static silicon rectifiers and voltage regulators incorporating magnetic amplifiers.

ADVANCES IN COAL-FIRED GENERATING UNITS

Year	Steam conditions			Design efficiency per cent.	Size of set MW
	Pressure lb./sq. in.	Temperature deg. F.	Reheat deg. F.		
1950	900	900	—	30.5	60
1956	1,500	1,050	—	33.7	100
1957	1,500	975	950	34.5	100
1958	1,500	1,000	1,000	35.6	120
1959	2,350	1,050	1,000	37.5	200
1962	2,300	1,050	1,050	37.7	275
1963	2,300	1,050	1,050	38.4	300
1964	2,300	1,050	1,050	38.7	350
1965	3,500	1,100	1,050	39.8	375
	(super-critical)				
1965	2,300	1,050	1,050	38.7	500

A 15-MW Bristol-Siddeley "Olympus" gas-turbine was ordered as an experimental peak-load plant. This unit incorporates the "Olympus" aircraft jet engine driving a generator, and is being installed as a joint venture by the Board and Bristol Siddeley Engines Limited, to assess the merits of this form of generation for peak-load operation. All units of 300-MW and above have turbine-driven boiler feed pumps which are integrated into the feedwater heating system. This type of drive is not tied to the electrical supply frequency and therefore has the advantage of choice of optimum speeds. The design of suitable machines and systems proceeded satisfactorily. In some of the earlier plants, the boiler feed pumps were placed after the feedwater heaters—which were subjected to an operating pressure of about one-third of the boiler pressure. The development of economical high-pressure feedwater heaters capable of operating at full boiler pressure has resulted in the placing of the feed pump before the heaters in the designs for the 350-MW and 500-MW plants ordered during the year.

Because the purity of feedwater to boilers generating steam at high pressures must be maintained at a very high standard, condensing plant designs incorporating an inter-space between the cooling water and the steam were developed, so that if a tube fixing leaks, the condensate is not contaminated.

Investigations into the possibilities of the low level, or stack, economiser showed that at the decreasing load factors of conventional plant, the economics are not so favourable for conditions in England and Wales as had been anticipated from American reports. The use of air instead of steam for soot-blowing in boilers received consideration, and experiments on this system have been arranged at Leicester power station.

A contract was placed for a digital computer and associated equipment to control automatically the start-

up of one of the boilers at West Thurrock; experience will be obtained from this installation of the value and reliability of the equipment. The first trial installation of automatic data logging equipment was commissioned at Northfleet, and a second was ordered. Experience with these two installations will indicate whether it is worth installing this equipment more widely in power stations.

An 11 kV distributing system is required in the new stations to supply the large amounts of electrical power required to drive the large auxiliary motors within the station; the voltage is stepped down to 3.3 kV and to 415 V for the smaller auxiliaries. Variable-speed slipring induction motors with liquid controllers will be increasingly used for driving starting and standby boiler feed pumps; the motors for the 375-MW super-critical unit at Drakelow "C," for example, are rated at 11,400 h.p., 11 kV, 980/490 r.p.m. At West Thurrock, slip energy recovery equipment was ordered for use with the variable-speed slipring motors associated with the electrically-driven boiler feed pumps. The tendency for circulating-water pumps to be designed for increased outputs at relatively low speeds has made synchronous motors more attractive than hitherto, and at Drakelow "C," the pump motors of this type have a rating of 3,300 h.p., 11 kV, 333 r.p.m.

Experience with the cooling tower at Staythorpe "B" power station demonstrated that asbestos cement can compete with timber for cooling tower packings, and a number of other towers with asbestos cement packing are now under construction. The extensive tests carried out at Staythorpe enabled the theory of counter-flow natural draught cooling towers to be further developed. The Board's engineers are collaborating with the manufacturers on the design of cooling tower shells with the aim of using computer techniques to refine the calculation of the reinforcement steel required for any size and shape of tower.

Transformers rated at 400 and 425 MVA will be required for the 350/375 MW generating sets now on order, and design work in connection with transformers suitable for the 500 MW sets rated at 570 MVA, stepping up directly to 400 kV, shows that the transport weight of a single three-phase transformer will not greatly exceed the maximum transport weight on which generator designs have been based. It was thought at first that two transformers, each rated at 285 MVA, would be required, but developments during the year suggested that one three-phase, 570 MVA transformer may be practicable, subject to detailed transport investigations.

Nuclear plant

Considerable effort was devoted to designing gas-cooled reactor cores which accommodate the changes in physical properties which occur during the irradiation of graphite. Where necessary, modifications were made to the cores of reactors under construction.

Work on fuel elements by the U.K.A.E.A. and the manufacturers engaged on the nuclear stations resulted in modifications to the design of elements to give adequate life in the reactors and the necessary design changes were incorporated into the first charges of fuel at Bradwell and Berkeley. During the preparation of safety reports to the Ministry of Power, extensive studies using large analogue and digital computers were carried out in reactor transient conditions. Special attention was given to the designs of the circuits and devices which protect the reactor from damage under fault conditions and the C.E.G.B. is supporting the development of components employing semi-conductors in place of conventional relays and thermionic valves.

Grid system

At March 31st last, the Grid system consisted of 7,532 route-miles of overhead lines and underground cables, of which 1,488 operated at 275 kV, 5,734 at 132 kV and the remainder at 66 kV or less. Some 474 miles of main transmission line were completed during the year. It was decided to adopt 400 kV for new main transmission lines due to be commissioned during and after 1965 and gradually to convert many existing 275-kV lines to 400-kV working. Works continued on the cross-channel power link which will connect the 275-kV Supergrid to the 225-kV French network. Cable laying for this £4.6 million project was completed in June.

Research

Research facilities were substantially increased in 1960/61. The new Berkeley Nuclear Laboratories were nearly completed (since opened in May), and the main laboratories at Leatherhead were considerably extended. The Marchwood Engineering Laboratories, near Southampton, were planned, and construction has since begun. Experimental and design studies related to more efficient steam-raising plant have included work on compact high-intensity combustion chambers, and the physical chemistry of water and the characteristics of materials to be used in supercritical boilers.

Research on combustion conditions includes laboratory and pilot-plant experiments and work in power stations, with the general aim of making it possible to build boilers with smaller combustion chambers.

Full-scale power station oil-burners are being tested in a pilot rig; the objects are to improve the design of burners, to reduce (a) the amount of excess combustion air, (b) sulphuric acid attack in the boilers, and (c) the amount of sulphur trioxide in flue gases. Two coal-burning rigs, nearing completion, will be used to study coal-burning systems over a wide range of operating conditions, and special attention is being given to deposition and corrosion in superheater steels at temperatures between 1,050-1,300 deg. F., and to combustion at temperatures above the melting point of the ash. Knowledge is being accumulated on the direct effects of changes in fuel and firing conditions on boiler flames, and on the probable effects of those changes on boiler fouling and maintenance. Newly-developed techniques are being used to study the behaviour of fuel ash, including the volatilisation, condensation, and fusion properties of the inorganic constituents. Further uses for pulverised-fuel ash are being studied by the Building Research Station, Glasgow University, and at the D.S.I.R. Warren Spring Laboratory.

The reclamation of ash-dumps, and their conversion into productive arable land continued to receive special attention. Cereal and root crops were successfully grown in several places on fields of experimentally-treated ash from power stations. The tolerance of plants to certain trace elements found in p.f. ash, and methods of reducing the effects of some of them which arrest or prevent normal plant growth, were investigated by

university research workers, supported financially by the Generating Board.

Experimental superheater

Work on the theory and practice of advanced steam-raising plant has been directed towards higher steam temperatures because, in general, the higher the steam temperature the more efficiently the energy stored in the steam can be used.

The experimental high-temperature superheater designed to study the Field cycle is being used to provide information on combustion and heat-transfer in pulverised coal flames, and to heat steam to higher temperatures than is possible in existing boilers. Preliminary investigations of flame temperatures and emissivity in a water-cooled chamber were completed in the Field cycle rig. When the superheater has been reconstructed with tubes and headers of high-temperature alloys, a further series of trials will be carried out. Tests on various steels designed to withstand high temperatures were continued at power stations, together with laboratory studies of the formation of corrosive deposits on the fire side of superheaters, and an extensive programme of research on materials was started. A complementary study was started on temperatures in advanced superheater designs.

Power station plant design and development in recent years has concentrated on progressively larger and more powerful units, but further substantial increases in operating temperatures may not be practicable with conventional designs. An alternative means of improving efficiency would be to produce gas from coal for use in combined thermal cycles. For example, the gas could be burnt in a gas-turbine, and the exhaust could be used in the combustion of the fuel residue to raise steam in plant at the present range of temperatures. Detailed design studies of this type have been started, together with the associated engineering experimental work.

Economic methods of storing power would be extremely valuable to the Board and the possibility of storing energy in the form of compressed-air has been suggested in several countries. The C.E.G.B. has made preliminary economic and technical feasibility studies which show that a scheme to compress air during off-peak periods, and to use it, in gas-turbines coupled to electrical generators during peak periods might ultimately help to economise in capital costs.

The economic and technical possibilities of several direct-generation processes, which may be of long-term interest, are being studied. The fuel cell, which converts chemical (fuel) energy directly into electricity, in principle enables higher thermo-dynamic efficiencies to be attained than is possible in existing heat engines. It is probably necessary for the fuel in the cell to be a gas, so that this research is linked with that on gasification mentioned above. In magneto-hydrodynamic (MHD) generation, an electrically-conducting gas is passed through a magnetic field and its energy is converted into electricity. The main problems arise from the high temperatures (2,000/3,000 deg. C.) which may be necessary, and from the extraction of electrical energy, into an external circuit. Thermionic generation, in which electrons are transferred from a hot cathode surface to a cooler anode across an evacuated space, is also being studied. Problems include the nature and behaviour of the electrode surfaces, securing an acceptable life for the materials, and engineering difficulties. Thermo-electric generation has also been examined, but the prospects do not look sufficiently promising to justify experimental work by the Board.

Some of these direct-generation methods, particularly MHD and thermionic generation, operate at such high temperatures that their " waste heat " is hot enough for steam raising; schemes to combine them with conventional power station plant to generate electricity at increased overall efficiency are therefore being considered.

Trading results

The C.E.G.B. had a deficit of £1.5 million. This compared with surpluses of £5.4 million for the previous year and £10.8 million for 1958/59. The deficit was, paradoxically, partly due to unexpectedly heavy sales of electricity during the year, particularly during August, September and October of 1960, when sales averaged 17.4 per cent. more than in the same months of the previous year. Consequently older, less efficient stations, many in high coal-cost areas, had to be operated to a greater extent than planned.

Trading income was £425.2 million, 11.4 per cent. more than in 1959-60, while expenditure at £426.7 million was 13.4 per cent. higher. Expenditure on fixed assets, at £196.2 million, was 8.6 per cent. less than in 1959-60. Of this, £106 million was spent on power stations, including £53 million on nuclear stations, and £31 million on the national Grid.

During the year under review, the Board reluctantly increased the tariff by approximately 2½ per cent. overall for the present financial year 1961/62, although over 1960/61 it retained the previous year's tariff. In raising the tariff, it took into account increased costs, including wage and salary awards and higher interest rates, and the policy of providing an increasing proportion of its capital needs from internal resources.

Over 111,400 million units of electricity were generated in the power stations in England and Wales during 1960/61, 10.8 per cent. more than in the previous year. This was the highest rate of increase recorded since 1954/55. The total of fuel consumed for all purposes amounted to 54.3 million tons, consisting of 48.9 million tons of coal and coke and 5.4 million tons of oil—a total of 58.1 million tons expressed in terms of " coal equivalent."

Average thermal efficiency of all 230 stations rose to 26.80 per cent., compared with 26.53 per cent. in the previous year, and 21.69 per cent. 10 years ago. The calorific value of the coal supplied to the Board during the year continued to fall. The average calorific value fell from 10,383 B.Th.U./lb. in 1959/60 to 10,206 B.Th.U./lb. in 1960/61. At the end of this March, the C.E.G.B. had 55,198 employees, 2,171 more than at the end of the previous year.

Associated Electrical Industries Limited has appointed a director of Manufacturing Services. He is **Mr. A. C. Main.** This appointment will, it is stated, ensure the co-ordination of manufacture throughout A.E.I. Mr. Main will be responsible for the constant review of the standard of manufacturing services and techniques, and the supply of trained and qualified staff in all the factories of the company. Mr. Main, who was Director of Manufacture of A.E.I. (Manchester) Limited, now reports to the A.E.I. Board through the Vice-Chairman. He remains as non-executive Director on the Board of A.E.I. (Manchester) Ltd.

High Temperature Dust and Fume Removal

EFFECTIVE control of hot, corrosive dust and fumes—as required by the Clean Air Act for example—often presents particularly difficult problems with gas temperatures exceeding 250 deg. F. It is with these "hard-to-collect" dusts in mind that the Dracco Division of the Fuller Company, Cleveland, Ohio, U.S.A., developed the Glass-Bag Filter, drawing on experience of 40 years in dust-control engineering. As its name implies, this filter embodies a glass cloth filter medium, by which efficiencies of almost 100 per cent. in the removal of hot, corrosive dust and fumes from gases at temperatures as high as 600 deg. F. have been demonstrated in full-scale applications. Low maintenance is an additional advantage for this design of filter.

Cloth filtration has long been recognised as the most efficient and practical method for dust and fume control, with its inherent advantages of high efficiency, low operating and maintenance costs and long-service life. For high temperature and corrosive conditions, however, the use of cloth filtration has been restricted by the operating limitations of the natural and synthetic materials commonly used in conventional filter bags, which are suitable only for temperatures up to 250 deg. F. and moderately corrosive conditions. Consequently, various types of mechanical or electric collectors often with limited efficiency and higher operating or maintenance costs have been employed.

The development of glass fibre cloth with the ability to operate at temperatures up to 600 deg. F., and be unaffected by all substances (except fluorine and hydrofluoric acid) seemed to offer an answer. The biggest problem in using glass fibre is the design of a filter housing to take maximum advantage of cloth filtration and yet obtain economical life of the bag. The consequent research and field testing has resulted in this filter equipment, which is marketed in this country by Constantin (Engineers) Limited, licensees of the Fuller Company. Collection efficiencies, it is stated, normally exceed 99½ per cent. with all visible particles being removed.

The filter bags used are of the single-hung tubular type. Adequate spacing between adjacent bags prevents bag contact during shaking. Bag suspension and shaking mechanisms are designed to assure correct bag tension, minimum wearing action and gentle, effective shaking. An important influence of high-temperature operation on filter design is the natural protection it gives ordinary steel against corrosive gases, since these higher temperatures are above the dew

(Above). *Tower type collector showing gas intake ducts and upper access doors.*

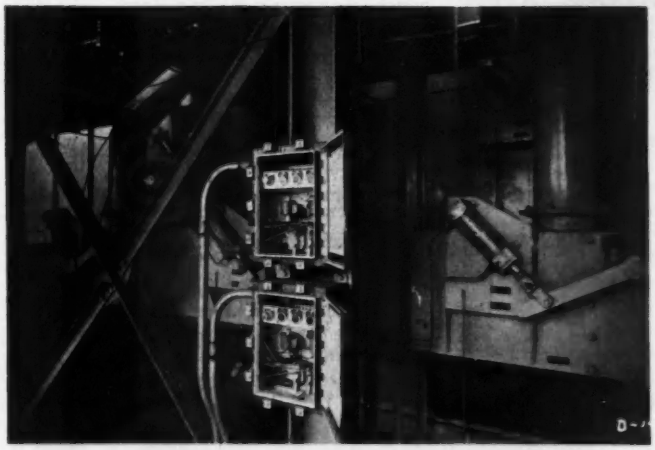
(Right). *Internal view showing glass fibre bags and connections to top crown sheet.*

point of the gases, preventing condensation. The hot gases pass directly on through the filter bags while all visible dust and fume particles are trapped. Where the dusts collected are themselves corrosive, the bags cannot be harmed, but the hoppers may require to be made of corrosion-resistant materials. In such cases, stainless steel or aluminium can often be applied.

Coupled with the application of the glass cloth filter medium, has been the development of bag-cleaning techniques to ensure continued high collection efficiency, while maintaining satisfactory life of the bags. Three methods have been evolved—sonic cleaning, reverse pressure, and bag-oscillation. Bag cleaning is regulated by a programme timer which maintains an automatic filtering-cleaning cycle. One compartment is shut down at a time for cleaning while the remaining compartments accommodate the dust load. An exceptionally fast cleaning time is claimed for each method.

Sonic cleaning, as incorporated in the Fuller Tower type collector, is suitable for most dusts. Sonic cleaning uses sound generators having a low audible frequency which causes the bags to vibrate. The noise level is not objectionable and the energy level is safe. The number of sound generators depends on the cloth area, the ratio being about one generator for every 2,500/3,000 sq. ft. of cloth. Reverse pressure is used in conjunction with sonic cleaning, the filter compartments being de-pressurised with reverse air flow, relaxing the bags and allowing the sonic energy to remove the dust. This noteworthy development extends the high efficiency and lower costs of cloth filtration into a new field of industrial applications.

(Above). View looking up tower interior showing access platform and sonic generator under platform.



(Left). View showing main gas inlet ducts and automatic sequence-operated valve mechanism.

Egyptian Power Station Extension

A £6 million contract for a 120-MW extension to the Cairo South Power Station has been awarded to the **English Electric Co. Ltd.** by the Cairo Electricity and Gas Administration. This order, one of the largest for British industry in the Middle East since 1957, was gained in the face of intense competition from firms in Britain, Czechoslovakia, France, Germany and the U.S.A. The existing generating plant is all of continental manufacture. The power station, when completed, will be one of the largest in the Middle East. Although English Electric are the main contractors and will co-ordinate the complete project, it is an Anglo-Egyptian enterprise in that Misr Concrete of Cairo, have a £750,000 contract for the civil engineering work. The plant should be in operation early in 1964. Since the second world war, English Electric have installed the complete electrical generating equipment in the Port Fouad power station, and have also supplied electric locomotives valued at about £4½ million to the Egyptian State Railways. The order covers the complete electrical and mechanical equipment to allow for the supply of a further 120-MW for the domestic and industrial use in the city. The two steam turbines for the 60-MW generating sets will be made at the Rugby Works of English Electric, the alternators, transformers and 63-kV switchgear at Stafford, and the low-voltage switchgear and fusegear at Liverpool. The four boiler units, each of 441,000 lb./hr. capacity, will be designed and supplied by Simon-Carves Limited, Stockport.

Mr. John Creek, M.A., has been appointed managing director of Fibreglass Limited. He joined Fibreglass Limited as general sales manager in May, 1952, was appointed to the Board as sales director in 1954, becoming deputy managing director earlier this year. He is chairman of F.A. (Membranes) Limited.

Progress at Hinkley Point

RECENTLY, we had the opportunity of paying another visit to Hinkley Point in Somerset to see the impressive progress that has been made there by the English Electric, Babcock and Wilcox, Taylor Woodrow Atomic Power Group, in the construction of the 500-MW nuclear power station for the Central Electricity Generating Board.

In previous issues of this journal, we have published accounts of progress made with both the civil engineering work, and with the mechanical engineering aspects of the construction programme at the site. Hinkley Point is situated on the Bristol Channel coast, about 11 miles to the east of Minehead, and about 10 miles north-west of Bridgwater. The site fulfilled the requirements for a nuclear station by possessing a good sub-soil, being close to deep water in the Bristol Channel, and being located in a sparsely populated area. In order to protect the 164-acre site, a sea wall nearly three-quarters of a mile long was built, and this has permitted extensive reclamation of ground on the landward side. Access to the site is by road, and considerable road improvement works have been undertaken on behalf of the C.E.G.B., at an approximate cost of £460,000, to permit the haulage to the site of the heavy electrical and mechanical plant components. A considerable amount of material has been brought by sea transport to Combwich, a small harbour on the estuary of the River Parratt, which has been reconstructed to handle material needed for the construction of the station.

Work began on the site in December, 1957, and the first half of the station is scheduled to be in operation by February, 1963, the whole station being completed by July, 1963. Progress at the station has now reached the beginning of what might be regarded as the final stage—that is, the laying of graphite in number one reactor. It is expected that the fuel loading of this reactor will commence during February next, followed by fuel loading of the second reactor about five months later. When work began in December, 1957, the station was then scheduled for completion in 1962. The time lost, mainly due to labour troubles, has, however, been put to good advantage by the incorporation of various design modifications. The station was ordered at a tender price of £60 million (including the cost of the initial fuel charge), but the design changes have added an extra sum, at present estimated to be approximately £5 million.

When completed and in full operation, the station will have a net output of 500-MW, the plant consisting of two natural uranium, carbon-dioxide gas-cooled reactors, supplying heat to 12 boilers. Six boilers are associated with each reactor, and will be arranged in two groups of three on opposite sides of each reactor to form a complete unit. Total steam production will be approximately 5½ million lb. of steam per hour, and this will supply six main turbo-alternator sets, each of 93.5 MW maximum rating, and three variable-speed turbo-alternators which will provide power for the gas-circulator drives.

The civil engineering works, which are being carried out by Taylor Woodrow Limited, are almost complete. Since construction first began, a total of 700,000 cu. yd. of shale and limestone have been excavated, 300,000 cu. yd. of reinforced-concrete laid, and 24,000 tons of steel reinforcement and structural members incorporated in the station buildings, etc. Concrete is now being poured to form the 5,000-ton, 11 ft.-thick pile-cap structure above the pressure-vessel of No. 1 reactor. This pile-cap will form the main fuel charging and discharging floor at a height of 100 ft. above ground level.

The first reactor building is virtually complete with passenger and goods lifts in operation, and with plant being installed to deal with loading of the uranium fuel and with instrumentation of the reactor. The burst slug detection apparatus is being installed, the precipitator panels are in position, together with their associated tubing as well as the motor-generator sets for the control rod motors. All six main gas-circulator casings for the reactor

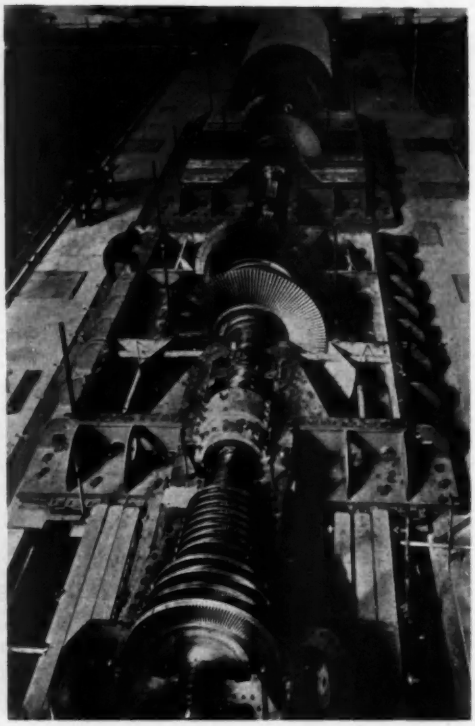
Drilling control charge nozzles on No. 2 reactor pressure vessel. Some of the standpipes are seen in position on the left.

are in place and some of the rotors for other circulator pumps are already on site. Within the 7 ft.-thick biological shielding walls, the 67 ft. dia. pressure-vessel, which was fabricated on site by Babcock and Wilcox Limited, is complete and has been successfully stress-relieved and pressure-tested, and is now being loaded with graphite. The six Babcock heat-exchangers or boiler units for the first reactor are now tubed (each complete boiler with its 22 miles of tubing, weighs 1,200 tons), and each of the boilers is being fitted with the steel gas ducts between them and the pressure vessel.

In the second reactor building construction of the pressure-vessel is also well advanced. This pressure-vessel has also been stress-relieved, and has successfully undergone its pressure test. The standpipes are being welded to the nozzles and the erection of the gas-ducting is proceeding. The main gas-circulator houses are now complete and all six driving motors for the circulators have been delivered. The 740 ft. long turbine house which is situated on the north side of the reactors is almost complete, and the first of the six English Electric main 93.5-MW turbines is being installed. Four of the main generator stators and two of the three 33-MW auxiliary turbo-generator stators have been delivered to site. Eight of the boiler feed pumps have been installed in the turbine-house basement, while in the transformer annex, two 11-MVA station transformers, four 110-MVA generator transformers and all the auxiliary transformers have been installed. Most of the switchgear has been erected in the electrical annexes and some of the instrument panels have been completed in the main control room.

Diesel engines will supply the standby power for the station, and all five 900 h.p. English Electric diesel engines, together with their motor generator sets, are installed in the diesel engine house. Other major

(Left). Each of the six 72-in. bore Drysdale centrifugal cooling water pumps has a 1,750-h.p. motor, and a capacity of 93,000 gal./min.



(Right). One of the six English Electric 93.5 MW main hydrogen-cooled turbo-alternator sets being assembled in the main turbine house.

plant on site and approaching completion includes the water-treatment plant, and the cooling water chlorination plant. The condenser cooling-water civil engineering works and plant, which represent such an important component of the station, are virtually completed. Band-type circulating-water screens, main valves and pumps have been installed. The complete-cooling water system incorporates the intake structure some 2,000 ft. offshore connected by tunnels to a deep pump-house onshore, distribution culverts and discharge works constructed at the eastern end of the site.

Twin water-boxes and tube-plates of the main condensers being coated with a liquid-applied synthetic rubber by Protective Rubber Coatings (Eristol) Limited, for protection against corrosion between cast-iron box and brass tube-plate with sea-water cooling system.

While the station will require 35 million gallons per hour, of water for cooling purposes, the intake structure is large enough to serve future tunnels and has been designed to be capable of taking in 85 million g.p.h. In the 70 ft. deep pumphouse, the cooling-water pumps and motors are now ready to deliver cooling-water to the system by six 72 in. bore vertical centrifugal pumps, each having a motor of 1,750 h.p. with a delivery capacity of 96,000 g.p.h.

The 400-ton capacity Goliath crane, which was designed and erected by Babcock & Wilcox Limited to handle plant and some of the heavy components from the prefabrication and stores area to the reactors, has been dismantled ready for transportation to the site of the 580 MW nuclear power station—the seventh in Britain's nuclear power station programme, which is now under construction by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group at Sizewell in Suffolk.

Oil Fuels and their Utilisation in Australia

THE University of New South Wales was the venue of the fourth biennial conference held by the Australian membership of The Institute of Fuel. It took place on August 24th-25th, and was attended by some 250 fuel scientists and engineers from all parts of the Australian Commonwealth.

Under the title "Oil Fuels and Their Utilisation" 12 papers were presented, with the object of stimulating interest in the advancement and practice of this branch of fuel technology. Though liquid fuels are playing an increasingly important part in the nation's economy, research and development work in their utilisation has so far been extremely limited within Australia. Consequently the papers were, in the main, up-to-date reviews of the present state of knowledge and practices in the utilisation of fuel oils and did not necessarily present the results of new and original research. The Symposium Organising Committee, under the chairmanship of Mr. F. H. Roberts, F.Inst.F. (chief engineer, John Thompson Australia Pty. Ltd.), had done an excellent job in editing and preprinting the papers, which were distributed to members well in advance, enabling them to prepare their contributions to the discussions.

The opening address was given by Professor J. P. Baxter, vice-chancellor of the University of New South Wales, and the closing remarks by Professor D. W. Phillips, pro-vice-chancellor. The chairman of the Australian membership, Mr. W. W. Pettingell, O.B.E. (general manager, Australian Gas Light Company), supported by Mr. S. L. Shirtley, M.Inst.F. (sales manager, Babcock and Wilcox of Australia Pty. Ltd.), presided at the first session of the Symposium and the other sessions were chaired by Mr. F. H. Roberts, Mr. S. L. Shirtley, and Mr. L. J. C. Wigan, M.Inst.F. (chairman, Adelaide Group; chief engineer Electricity Trust of South Australia). Mr. J. M. Austin, M.Inst.F. (chairman, Melbourne Group; combustion engineer, Shell Company of Australia) was the official rapporteur and Prof. N. Y. Kirov was hon. secretary of the Organising Committee.

More than 200 members and guests were present on the first evening at the annual social function of the Sydney Group of the Institute, held this year in conjunction with the Symposium. The gathering afforded an opportunity for the renewal of contacts between members of the Institute from all over Australia.

We give below some notes of three of the papers of special interest to boiler operators and steam engineers.

Other papers to the Symposium dealt with the characteristics of oil burners in relation to atomisation and combustion (C. H. Humby); design of packaged oil-fired water-tube boilers (R. D. Palmer) and of oil-fired shell-type boilers (B. V. Breen); use of liquid fuels in continuous ceramic kilns (A. Galtegno) and in industrial furnaces (D. Bramhall); oil fuels for gas manufacture (B. B. Bennett) and as supplementary fuels for blast furnaces (W. Howarth); and trends in heat engines and their fuel requirements (D. C. Cooper). In addition, an

overseas paper by Professor M. W. Thring, of Sheffield University, was presented on his behalf.

Properties of Oil Fuels and Their Significance in Utilisation (N. Y. Kirov)

This review of recent developments points out the increase in the contribution of petroleum products to the total energy requirements of Australia, from 23 to 38 per cent. in the period from 1948/49 to 1958/59. Between 1953 and 1961 seven refineries have been built, increasing Australia's refining capacity from 22,000 to 260,000 brl. per day. Imports of crude oil in 1960 were 2,920 million gal., of which 67 per cent. came from the Middle East.

Despite recent reports that the discovery of flow oil in Queensland is "still inconclusive," the search continues. Success would have a profound effect on the Australian economy. Samples of crude oil from exploratory drilling operations in Australia and New Guinea have proved to be light to medium paraffin-base crudes, with similar characteristics to those of Borneo and Indonesia.

The paper deals also with the properties of oil fuels currently being marketed in Australia, and their suitability for particular applications. Statistical and analytical data, illustrating some of the points discussed, were summarised in 10 tables.

Sulphur in Oil Fuels—Its Effect in Combustion (N. Y. Kirov); and *Problems Associated with Minor Impurities in Oil Fuels* (D. Barrett)

These two papers are concerned with a problem which came under review at a previous symposium of the Australian membership of the Institute, namely, that on "Australian Fuels and Their Utilisation," held in Newcastle (New South Wales) in 1959. On that occasion it was recommended that the practicability should be examined of setting up a committee to co-ordinate research into the causes and prevention of fireside deposits and corrosion in fuel-using plant and to assist in the dissemination of all available information. Subsequently, a special independent committee was constituted, under the chairmanship of Dr. C. R. Kent, which has established liaison with the U.K. Boiler Availability Committee.

Professor Kirov points out that, of the crude oil processed by Australian refineries during 1960, 32 per cent. was from Indonesia and British Borneo and the remainder from the Middle East. The sulphur content of the former is very low and of the latter is between 1-3 per cent. The tendency in recent years has been for the proportion of Middle East crudes to grow, and an increase can therefore be expected in the sulphur content of oil fuels marketed in Australia.

The presence of sulphur in fuels reduces the maximum practicable efficiency of utilisation, increases plant maintenance, and limits the extent to which waste heat can be usefully recovered in air heaters and economisers, since it encourages the formation of deposits and corrosion in boilers. The key to the deposit and corrosion problem in industrial plant is the conversion of the sulphur dioxide in the flue gases to sulphur trioxide. It has been shown experimentally that reduction of the excess air to a point where incomplete combustion is obtained, can eliminate almost entirely the sulphur trioxide in the combustion gases.

Professor Kirov next reviews the techniques which have been developed for studying the condensation characteristics and concentrations of sulphur oxides in combustion gases, and the various remedial measures available which have been tried with varying degrees of success. These include: (1) combustion control; (2) use of additives; and (3) protective coatings.

In Australia, successful results have been obtained at the Osborne power station of the Electricity Trust of South Australia using the B.P. corrosion control method, which involves the introduction of a metered quantity of gaseous ammonia into the flue gases. Boiler efficiencies were raised by 1-2 per cent. and corrosion in the air preheaters virtually eliminated.

Professor Kirov concludes with a reference to air pollution caused by sulphur oxides from combustion gases, and mentions that a Clean Air Bill is about to be presented before the New South Wales Parliament. Already this has stimulated interest in the prevention and control of air pollution, and members of the Institute look forward to participation in a conference on the subject which is to be sponsored jointly by the N.S.W. Department of Public Health and the University of New South Wales.

In his paper (*Problems Associated with Minor Impurities in Oil Fuels*) Mr. Barrett draws attention to the tendency in recent years for the ash content of residual fuel oils to rise; at the same time there has been a general increase in the working temperatures of fuel-using equipment. Vanadium, which causes most of the deposit and corrosion trouble, may be present in the parent crude oil both as oil-soluble and water-soluble material. It acts as an acid radical, forming vanadates which are frequently of low melting point and may deposit on the cooler portions of the furnace, causing blockages and corrosion. Further, the presence of vanadium pentoxide appears to assist the decomposition of sodium sulphate to form Na_2O and SO_3.

Mr. Barrett mentions, in conclusion, the measures which have been tried to prevent deposits, or at any rate to modify them in such a way that they become easier to remove. Increase in combustion efficiency and reduction in excess-air requirements should help, both by reducing production of sulphur trioxide and by producing lower oxides of vanadium which have high melting points.

Fuel Laboratories at University of New South Wales

Between the sessions, delegates to the Symposium were able to inspect the Department of Fuel Technology of the University of New South Wales, the first and only university fuel department in Australia. Established in 1958, it has modern and well-equipped laboratories, and not only offers facilities for degree and diploma courses in fuel technology at the undergraduate and postgraduate levels but also "services" other departments of the university—namely, Applied Geology, Mining Engineering, Chemical Engineering, and Ceramic Engineering—so far as training in fuel is concerned.

The United Kingdom Atomic Energy Authority announce the appointment of **Mr. H. V. Disney**, C.B.E., M.I.Mech.E., at present deputy managing director, as managing director of their Engineering Group, to succeed **Mr. J. B. W. Cunningham**, M.I.Mech.E., who is, as mentioned elsewhere in this issue, resigning as from January 20th, 1962, to become managing director of Dewrance & Co. Ltd.

N.I.F.E.S.—Seventh Annual Progress Survey

THE belief that the National Industrial Fuel Efficiency Service has now achieved a recognised position in industry and that its clients will accept the need to pay a fair price for its services, was expressed by its chairman, Sir Leslie Hollinghurst, G.B.E., K.C.B., D.F.C., in his statement contained in the seventh annual progress survey. The survey, presented recently in London, covers the year ended March 31st, 1961, during which period an engineering staff 10 per cent. smaller than the previous year achieved increases in revenue, earnings and in takings of nearly 20 per cent.

The increase in competition abroad, combined at home with costs continuing to rise and profit margins to close, compelling industrialists to apply their attention more than ever to a reduction in their manufacturing costs, leads Sir Leslie to be confident in the future developments of N.I.F.E.S. service to industry.

The decision announced last year that industrial users of fuel should meet the full cost of the services which they were receiving and from which they were deriving substantial financial advantages, has had the effect of recovering an increasing proportion of the costs of the fee-earning services. This year, the earnings expressed as a percentage of cost are as high as 70, compared with 58 and 53 for the two previous years. The service fees were still further increased on January 1st, 1961, but that date is too recent for the results to be reflected in the accounts now presented.

One factor which has affected the results was an abnormal loss of engineers owing in major part to the decision of the National Coal Board to enlarge its technical service to consumers of coal. As a result, the number of technical staff fell from 219 to 192. Rather than attempt to meet these losses by widespread recruitment, it was decided to make an opportunity for consolidation by concentrating more of the staff in the areas where the demand was proving greatest. Therefore, the engineering staff has been held constant in number during 1960/61. Turnover of staff has now fallen back to a more normal figure. Nonetheless, the year has been one of special strain not only for the supervisory and senior staff, but especially for the younger assistant engineers who have had to make rapid strides to fill the gaps caused by resignations.

Results

With a 10 per cent. reduction in engineering staff and with the problem of securing work at increased charges to be tackled, it might have been considered satisfactory if the results for 1960/61 had matched those secured in the previous year. In fact, the industrial income shows an increase of nearly 20 per cent. at £200,610 for 1960/61 as compared with £167,980 for 1959/60. Earnings, which take into account value of work in progress at the start and end of the financial year, are up from £182,391 to £210,910. Making allowance for the smaller staff, this represents an increase of one-third in the earnings per engineer. Much of the work undertaken during one financial year is completed and paid for during the following year. The total value of the takings made in 1960/61 is thus some indication of the revenue to be expected during the next financial year. It is most encouraging that takings during 1960/61 showed an increase of 20 per cent. over 1959/60, at £251,693 as compared with £209,971. Every figure quoted for 1960/61 represents a greater advance over 1959/60 than that year showed over 1958/59. As a result of increased revenue from industry and of lower expenditure on fixed assets, there has been a further reduction this year in the drawings from the nationalised fuel industries. It was necessary to call upon them for more than 75 per cent. of their guaranteed contributions of £450,000 as compared with 82 per cent. in the previous year. Subscriptions from the major oil companies, Shell-Mex & B.P. Limited and the Esso Petroleum Co. Ltd., have also been reduced.

These contributions cover such deficiency as still exists on the fee-earning service but the greater part is used to support those activities of a public service character which the Board have never expected to be self-supporting. These include a substantial effort devoted to practical training in which full N.I.F.E.S. courses for boiler operators are perhaps the most widely known. By way of interest, the number of operators trained for the City and Guilds Certificate, which had been declining for some years, increased in 1960/61 from 476 to 647. The provision of articles in technical journals and addresses to industrial societies represents a big contribution to the advance of engineering and production efficiency, the report adds.

Another factor which has a considerable bearing on the progress towards becoming self-supporting is that N.I.F.E.S. has had to be organised on a nation-wide basis. Its services are available in every part of the country, however remote; they are not concentrated solely in the more industrialised, and therefore profitable, areas.

The report mentions work outside this country, particularly in Eire, Canada and India, and that applications from Israel and Argentina for N.I.F.E.S. assistance are under negotiation.

During the year, N.I.F.E.S. engineers paid more than 11,000 visits to factories and premises where large quantities of fuel are used. During these visits, they carried out fee-earning work for 1,141 clients, including 585 who called upon N.I.F.E.S. advice for the first time. The trend towards placing the work on a continuing basis is still growing. The number of regular service agreements, whereby N.I.F.E.S. engineers make regular visits to a works, or are retained to undertake surveys as the need arises, increased by 11,000 during the year.

The core of N.I.F.E.S. work remains the investigation of combustion conditions in boiler plant. Thermal efficiency tests on the 465 boilers were made during the year. General inspections were carried out on hundreds more. In the last seven years, efficiency trials have been completed on 2,871 boilers consuming nearly five million tons of fuel per annum. The report states that this year's results confirm that when a boiler plant comes into the hands of N.I.F.E.S., the consumption of fuel on average can be reduced by one ton in seven.

A section of this survey is devoted to boiler house problems which have grown in importance since the Clean Air Act came into force. During the year, there

has been an increased demand for advice on the emission of grit and dust. The conditions in which effective grit arresters must be installed are stated in the Clean Air Act, although no limits have been specified for the amounts of grit and dust that may be emitted. Curiously enough this lack of regulation on quantity has led to a demand for measurement so that the local authority may be satisfied that the arresters are effective. So N.I.F.E.S. offices have been provided with apparatus for measuring grit emission and for analysing the size distribution of the material discharged. Besides determining the effectiveness of grit-collecting equipment already installed, the measurements can be used where advice is required on new construction. Assistance to the designers of equipment as well as to the users has also been afforded.

An instance of this is Joshua Bigwood Limited, of Wolverhampton, who had developed the prototype of an inertial grit arrester for vertical boilers and asked N.I.F.E.S. to assist in a comparison of service performance with design performance. The efficiency of grit collection was determined at different settings of the arrester. The information thus obtained made it possible to simplify the design of the production model.

The service has also been called upon to investigate the problems of steel chimney corrosion, an example being for Newhall Dairies, Aston, Nantwich, the three 55-ft. chimneys of which were being rapidly attacked. The temperature of the flue-gas and chimney metal was taken at three points on the lower half of one of the chimneys, and from these measurements, it was concluded that the chimneys should be insulated with aluminium sheeting incorporating a ¼-in. air gap. Repeat measurements after the chimney had been insulated showed that the temperature of the steel had been raised by about 170 deg. F., hence it could be predicted that even the top of the chimney could be kept above the temperature at which condensation led to serious attack.

The progress survey also gives details of the training courses for boiler operators covering boiler operation, new developments in firing solid fuel, and oil firing; and of refresher courses for works and plant engineers. A considerable section deals with investigation of the process side of many industries including motor, whisky distilling, brick, and pottery.

High Voltage Circuit Breaker Development

DEVELOPMENTS in the design of high voltage air blast circuit breakers by the English Electric Co. Ltd. and the provision of adequate testing facilities for these units at its Stafford Works were disclosed in a "Switchgear Symposium" arranged recently by the company. Of the new range of high voltage air blast circuit breakers, some equipment has already been ordered for the first 400 kV switchgear for the C.E.G.B. to the value of about £1½ million. The order covers thirteen 35,000 MVA air blast circuit breakers, eight of which will be rated at 4,000 A and five at 2,000 A, together with the power operated isolators and other apparatus to form a complete duplicate busbar switching station, to be installed at West Burton power station. This is believed by English Electric to be the heaviest rated equipment of this type ordered so far in the world.

English Electric pioneered the commercial application of air blast circuit breakers in the United Kingdom, and in 1940, supplied a 6.6 kV 150 MVA air blast circuit breaker for controlling the arc furnace transformer in the Brymbo Steel Works. A complete range of air blast breakers was subsequently developed and in 1947, the first 132 kV air blast breaker was installed at Northfleet on the British Grid; this design was later extended to 275 kV. In all, the company has supplied some 1,300 air blast breakers for all parts of the world. All these breakers are of the conventional design, with the compressed air stored in receivers at ground level, blast valves located at the base of the support columns, and incorporating make switches.

Foreseeing the development of increased current rating for overhead transmission lines, the company decided in 1957 to evolve a new design of circuit breaker suitable for voltages from 132 kV up to 650 kV and possibly higher, current ratings of 2,000-4,000 A and short circuit ratings up to 50/60 kA and very short break times. This has resulted in the frame "r" breaker. In this design, the contacts are pressurised at full air pressure both in the open and closed positions which involves a downstream blast valve, so that full air pressure is available at the interrupter contacts at all times. The breaker is controlled and operated mechanically right up to the pilot valves located at line potential adjacent to the blast valve. This cuts out the time delay and ensures very fast operating times at all voltages and under all conditions.

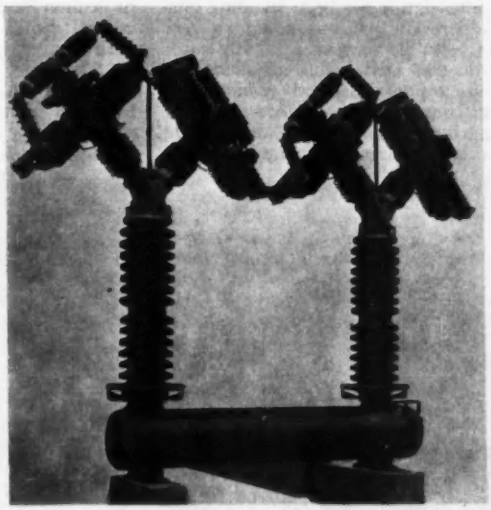
The arcing contacts do not part until approximately half the travel is completed, thus increasing the speed of opening. The mechanism ensures very short opening times and the combined effect is a guaranteed 2½-cycle operation at any voltage and extremely good interrupting performance, which is particularly noticeable on line charging and capacity currents. The omission of the make switch minimises air consumption, and eliminates external moving parts subjected to the possibility of icing and other adverse weather conditions. Interrupters can be arranged either in "Y" formation with four interrupters per support column (as the accompanying illustration shows) or in "T" formation with two interrupters per column; or in combination of both. With breakers with two or four interrupters per phase, all three poles can be accommodated on one air receiver. Air at 300 lb./sq. in. is contained inside the support columns and interrupter porcelain within epoxy resin-bonded glass tubes. These tubes, by means of pretensioning, hold the outer porcelain weather sheds in compression. The outer space between the tubes and porcelain is permanently air conditioned at a positive pressure of 2 lb./sq. in. above atmospheric. Maximum flexibility has been aimed at throughout the range, and the design allows for various ratings to be met by use of multiples of the unit interrupter connected in series horizontally, being extendible to the higher voltages. Manufacture is possible on a unit basis, each

unit being fully works tested separately, avoiding the necessity of assembling the complete breaker in the works.

Increased capacity of high power laboratory

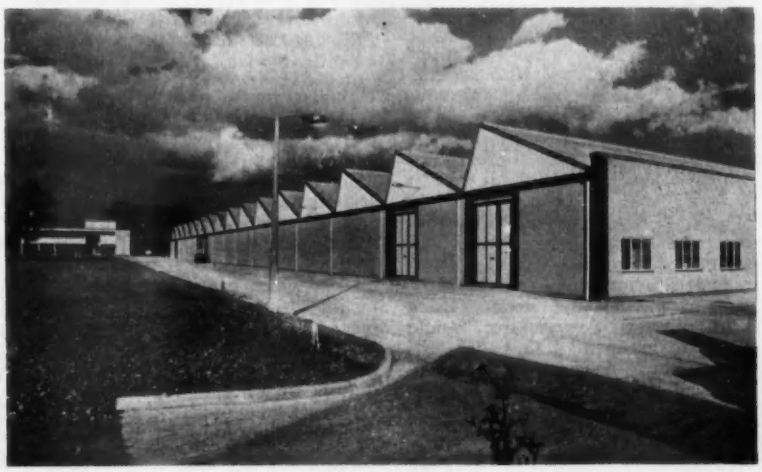
To prove breaker ratings up to 50,000 MVA at 500 kV and above satisfactorily, and to keep the number of interrupters to the required minimum, it has been necessary to increase the capacity of the plant at the Nelson High Power Laboratory at Stafford. The existing plant consists of two 3,000 r.p.m. alternators with associated transformers and ancillary equipment. To increase this capacity two new alternators are being installed, together with associated transformer banks and full ancillary equipment, with a capacity to test at voltages up to 600 kV. A single building, forming the bar of a "T" formation with the existing hall, houses both new machines and ancillaries, transformer banks being contained in outside areas at either end of the building. Conducting paths have been kept short by roof-mounted bus runs, linking both outputs to the overhead lines and ingoing feeders to the test areas. New features in the plant design include the provision of servo-control for the synchronisation of four machines; and the installation throughout of pressure-immersed make-switches, which give close control of point on wave of voltage application and negligible pre-arcing. Each switch has a making capacity rating of 300 kA peak. Where possible, up-to-date insulating methods and materials have been employed, an example being the encapsulation of reactor coils in synthetic resins. Plant application has been increased by the use of air blast back-up breakers, giving improved control and safety. The provision of extra plant has more than doubled the output of the existing equipment which itself was doubled in 1947. However, if the present trend in the increase of circuit breaker ratings is maintained, the company believes a form of synthetic testing acceptable to users may well be the only economic means available for proving circuit breaker performance.

An eight-interrupter breaker in "Y" formation suitable for 400 kV 25,000 MVA.



NEW EXTENSIONS AT MUREX WORKS

Extensions costing in the region of £350,000 have recently been completed at the works of Murex Welding Processes Limited, at Waltham Cross, Hertfordshire. The new buildings consist of a 500 ft. long single-storey production shop having an uninterrupted floor area of 62,000 sq. ft. for the manufacture of electric arc-welding plant and a two-storey office block of 7,200 sq. ft. to accommodate the plant sales department, drawing office and works engineer's department. The extensions represent a further stage in the planned development of the Murex works which at the time of its erection in 1938 was considered to be the largest all-welded single storey factory in Europe. The new buildings are designed to provide the additional accommodation required to meet the consistently increasing demand for Murex metal arc-welding electrodes and equipment both at home and abroad. The all-welded steel frame and roof construction of the new plant shop follows the same design as that of the original factory building which created widespread interest by demonstrating the large uninterrupted floor areas which could be obtained by means of welded construction. The new factory extension is not joined to the main building, but is sited so that a connecting bay between the two can be added at a future date. The new office block has been designed to incorporate the latest ideas in modern office accommodation, and is equipped with a warm air heating system, electric under-floor heating in the foyer, and glare free artificial lighting of high luminosity. The external walls generally consist of a curtain walling of aluminium alloy frames, with double sash windows and metal infill panels. The end elevations are of brick construction and allow for future extensions.



General view of new Murex extensions at Waltham Cross, Hertfordshire, showing on the right the 500 ft. production shop, and in distance the two-storey office block.

RECENT Equipment AND Accessories

Out-door boiler shows financial saving

Although it has been standing out-of-doors since it was bought a year ago, a "Powermaster" fully-automatic packaged boiler installed at a Southampton chemical manufacturing company has saved the firm £3,500 in steam costs during the first 12 months of operation. The

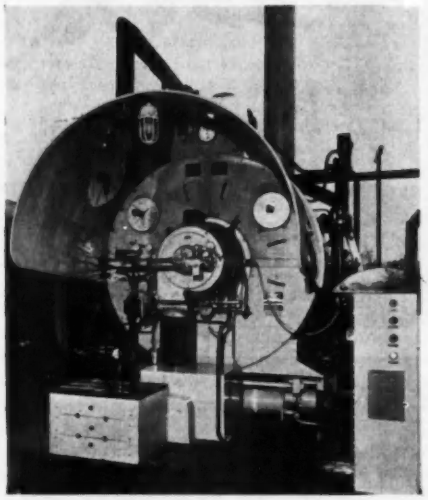


Fig. 1. "Powermaster" packaged boiler installed at Southampton. (G.W.B. Furnaces Limited.)

company, Burts & Harvey Ltd., has been continually expanding the operations at their works at Spring Hill, Bitterne, and this factor has made it extremely difficult to make an accurate forecast of future steam requirements. For this reason they decided to defer the building of a boiler house. In 1960, the company replaced its vertical type oil-fired boiler with a "Powermaster" supplied by G.W.B. Furnaces Limited of Dudley, Worcs. (Fig. 1). From the outset they decided that until the future steam requirements could be determined, a factor which could necessitate adding to the steam raising plant, the new "Powermaster" would stand in the open. The boiler rests on a robust concrete base and is protected from the weather by two steel canopies which cover the boiler's exclusive Voriflow burner and electrical control panel. These were made and fitted by G.W.B. engineers. It was the intention to provide further protection for the burner and electrical control panel had this been found desirable in the winter weather but, in fact, this did not prove to be necessary. Despite the fact that it has been exposed to the elements for more than a year the thermal efficiency of the boiler is still 83 per cent. and it is reported that it has been completely trouble-free. The boiler, a Model 200, is capable of raising 6,900 lb./hr. steam, but so far the demand made on it has been appreciably less than this figure. This steam is utilised for general process heating and distillation. Only a small proportion is used for space heating at the present time. It runs for 24 hours a day, six days a week, and by comparison with its predecessor, has lowered steam costs by £3,500 per year. Although the boiler is running for 144 hours per week no full-time boiler man is employed. The part-time boiler man, under the supervision of the engineering staff, makes spot checks and carries out periodic cleaning and maintenance, while at the same time being otherwise usefully engaged. The "Powermaster" is also completely smoke-free when working at part or full capacity, which is an important advantage because the works are situated quite near to several blocks of multi-storey flats. (*G.W.B. Furnaces Ltd., Dibdale Works, Dudley, Worcs.*)

Polariscope for photo-elastic stress analysis

The Sharples Polariscope has been described as a practical engineers' tool for the assessment of designs as well as for serious research work and university and technical college lecture purposes. It is a compact instrument mounted on its own cabinet which contains storage space for models and special loading equipment. The 5½ in. dia. polariscope can be used either as a diffused light or as a transmission instrument. The diffused light type is more suitable for visual examination as glare effects from the lenses are not present, more adaptable for quick measurement of results and allows good definition of fringe photographs to be obtained. On the other hand, the transmission type is very convenient for group demonstrations as the images of the stress patterns can be projected on to a screen, and the projection system facilitates the drawing of isoclinic lines as these can be traced on the screen for various degrees of angular rotation of the polariser and analyser. Also the alignments of model boundaries in the image are better in the transmission polariscope. [*Sharples Engineering Co. (Bamber Bridge) Ltd., Horley Road, Walton-Le-Dale, Preston, Lancs.*]

Non-concussive valve for liquids or gases

The Perrett Hydrovalve, which is a globe-type valve designed to control the flow of liquids or gases up to a pressure of 125 lb./sq. in. has been produced for operation by remote pneumatic or hydraulic control. This

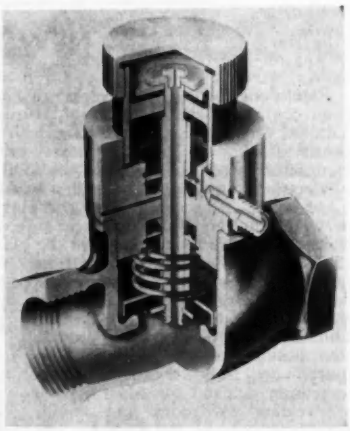


Fig. 2. Perrett Hydrovalve. (Perrett Control Co. Ltd.)

valve is non-concussive in action and thus eliminates problems of hammering in fluid systems. It is constructed in non-ferrous metals throughout with synthetic rubber valve-seats, piston cups and gland seals. It is a globe valve of the "under and over" type with renewable disc seat, and incorporates a unique feature in its design as the line pressure itself ensures a tight shut-off. When the

valve is closed, the liquid or gas entering the inlet passes through the hollow spindle, fills the cylinder at the top of the unit and acts upon a piston. This piston, having a greater surface than the valve disc, keeps the seat firmly in the closed position despite variations in line pressure. The application of the control pressure to the lower part of the piston overcomes the downward thrust and causes the valve to open. The rate of opening is controlled by the size of the interchangeable nozzle fitted in the bore of the hollow spindle, and the control pressure necessary to open the valve is considerably lower than the line pressure. When the control pressure is released, the line pressure on the top of the piston, aided by a small phosphor-bronze return spring closes the valve. The rate of closing is again determined by the size of the nozzle which controls the charging of the upper cylinder, and it is this feature which produces the non-concussive closing effect. The Hydrovalve is simple and positive in action and its size is stated to be only two-thirds that of its manually-operated counterpart. All components are readily accessible for servicing. A screw-in hand-wheel bonnet is available for use during interim periods. The valve is available in sizes ranging from ⅛ to 3 in. with B.S.P. or American N.P.T. threads and flanges. (*The Perrett Control Co. Ltd., Green Lane, Hounslow, Middx.*)

Phosphating process

The Paints Division of I.C.I. has developed a non-aqueous phosphating process which dispenses with rinsing, and tank-heating, forms no sludge in the processing tank and produces a sealed phosphate coating. The phosphate coating enhances paint adhesion and resistance to rust creep in the same way as conventionally-produced zinc or iron phosphate coatings. The improvement in the corrosion resistance of paint systems is outstanding and the possibility of work being contaminated by water-borne impurities is eliminated. The process for which patents are pending will be known as Kephos. It contains a sealer which is sufficiently corrosion-resistant to protect work during transport or temporary exterior storage for up to a week, or indoor storage up to six months. Under normal production conditions, work can be welded through the Kephos film, enabling items to be treated before fabrication, so that shrouded areas such as interior box sections receive some protection. It is not confined to dipping. It may be applied by brush, roller, spray or flow-coating, the most suitable method depending entirely on the characteristics and number of the articles to be treated. It can also be used to supplement existing phosphating facilities when an article is too large for the plant or an abnormal volume of work requires processing. (*Imperial Chemical Industries Limited, Millbank, London, S.W.1.*)

Pneumatic impact wrenches

The new "400" series of pneumatically-operated impact wrenches by the Airetool Manufacturing Company have a ½ in. bolt capacity with

Fig. 3. Pneumatic impact wrench. (Airetool Manufacturing Company.)

a ½ in. female hex, quick-change chuck, ¾ in. and ½ in. drive squares. All models have a ¼ in. pipe tap, and they are available with either pistol grip or straight-type handles. Operating on low air consumption, these lightweight wrenches have a high run-down speed. The impact mechanism does not depend upon springs or centrifugal force for operation, and is so designed that it is, under all conditions, reversible, with full power in either direction. These impact wrenches have a wide field of application. (*Airetool Manufacturing Company, Springfield, Ohio, U.S.A.*)

Versatile patterns for nameplates

Any combination of 300 backgrounds can now be incorporated at no extra cost to a new range of patterns for industrial name-plates, escutcheon panels, instrument fasciae, dials, etc. The plates can be supplied deeply etched and/or anodized in black or any combination from a wide range of permanent dyes. The degree of etching available enables plates with three-dimensional effects to be obtained, while the colours remain true to shade, irrespective of production quantity. Complete freedom of nameplate patterns is claimed. The production of this new range of plates is made possible by electronically-controlled etching and anodising plants. (*Millett Leavens Limited, Stirling Corner, Borehamwood, Herts.*)

Flue dust removal plant

A heavy-duty vacuum cleaner and flue-dust removal plant known as the Bivac "FDP" has recently been introduced by Bivac Air Co. Ltd. This machine has been produced to meet the need for a portable industrial suction unit where rapid removal of ash and powdered material is required. It is suitable for boiler flue-dust and p.f. dust removal. A large storage capacity is provided, designed to be suitable, if required, for the removal of hot dust (such as boiler flue-dust). For bulk removal the rate is between two and three tons per hour using two operators, each with a 30-ft. length of hose and aerated suction nozzle. One or two operators can use the machine at the same time for bulk removal, or three to four operators on general vacuum cleaning work. The Bivac patent "Clear-Flo" filter is used in the final filtration stage, and the total dust storage capacity available is 10.5 cu. ft. giving a working capacity of 735 lb. of flue dust at 70 lb. per cu. ft. A special unloading trolley is provided for the removal of the three main dust containers when full. (*Bivac Air Co. Ltd., Marsland Street, Stockport, Lancs.*)

Fig. 4. Flue dust removal plant and heavy-duty vacuum cleaner. (Bivac Air Co. Ltd.)

Industrial centrifugal fan

The Sirocco "U" type centrifugal fan for general industrial application has been developed by Davidson & Co. Ltd. The "U" type fan is a standard belt-driven unit of the free standing type which is manufactured in 12 sizes. A feature is the choice of

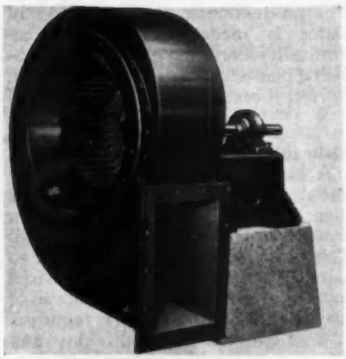


Fig. 5. Sirocco "U" type fan with U.F.B. 70 runner. (Davidson & Co. Ltd.)

three runner designs which enables the fan to be used for the greater majority of fan applications. The fan is of the wide-casing type having a high volumetric capacity which varies to a small extent with the type of runner which is fitted. The U.F.B. 70 model is a general-purpose type suitable for the handling of clean air or gas, although modest amounts of suspended matter in the air or gas will not result in harmful effects. It may be used as a forced- or induced-draught fan on boilers of the Lancashire or Economic types fired by hand, by mechanical stoker, or by oil. The U.B.C.B. model covers the same field of application, but has a slightly higher efficiency where high power consumptions are involved. Having a laminar plate blade curved backwards to the direction of rotation, it can handle gases containing some suspended matter and is thus particularly suitable as an exhaust fan for kilns, furnaces or boilers calling for a relatively high pressure. The U.B.A.B. model of this type of fan in its standard form has aerofoil blades and is particularly suitable for the larger duties met with in industry, such as the supply of forced-draught to a boiler or of combustion air to a furnace. (*Davidson & Co. Ltd., Sirocco Engineering Works, Belfast.*)

Portable oxygen cutting machine

A portable lightweight oxygen cutting machine, now being marketed by British Oxygen, weighs 21 lb. and can cut and bevel steel up to 2 in. thick. Known as the "Pug," the machine runs on inexpensive light alloy track, and can make a straight cut of any length. Circles, of 3-45 in. dia. can be cut with the use of an adjustable trammel attachment, while the cutter can be moved through angles up to 45° for bevelling, and can be adjusted vertically and laterally. Power is supplied by a universal electric motor suitable for a.c. or d.c. at voltages of 220/240 or 110, and with a maximum consumption of 80 watts. This gives a speed range from 7.3 to 36 in. per min. Speed control is by rotary-type resistance. The nozzle-mixing blowpipe uses acetylene or propane as fuel gas. Another feature is a wrap-around handle for easy carrying and protection. This machine is the outcome of intensive design studies and field tests. (*The British Oxygen Co. Ltd., Bridgewater House, St. James', London, S.W.1.*)

Range of f.h.p. motors

Crompton Parkinson Limited are introducing a new range of f.h.p. motors which comply with the requirements of B.S.170 and have the mounting dimensions of American standard N.E.M.A. 42. There are four main types of motor: (a) shaded-pole, which is a new addition

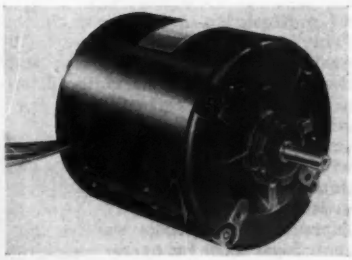


Fig. 6. Crompton T.30 f.h.p. motor, endshield mounting. (Crompton Parkinson Limited.)

to the C.P. range and has been specially-designed to ensure a low noise level; (b) capacitor start induction run; (c) capacitor start and run; and (d) split-phase start. These four types are all available with drip-proof enclosure, and, in addition, the shaded pole motor can be supplied as totally-enclosed airstream and totally-enclosed still air rated. The motors with resilient base have a centre height of 2⅛ in. Designated T.30, this range of motors with its clean lines and compact design is suitable for fan drives on air-conditioning plant, cooler units, unit heaters, small workshop appliances, laboratory equipment and so on. The range makes provision for four popular methods of all-angle mounting, including resilient base, resilient rings without base, endshield pad with tapped holes and endshield pad with extended studs. To comply with N.E.M.A. standards, the motors have a ⅜-in. dia. shaft extension. Bearings, however, allow for ½-in. dia. shafts to be provided at either end of the machine for small extra cost. The oil wells carry a large amount of oil and when charged contain enough oil for two years running at normal ambient temperatures and hours of operation. The oil cannot be spilt, being absorbed in a felt developed for this purpose and which supplies a free flow of filtered oil to the bearings. The split-phase and capacitor start induction run motors employ a starting relay which is separately mounted and is suitable for all-angle mounting. Capacitors for capacitor start induction run and capacitor start and run motors are also separately mounted. The T.30 range is available for single-phase working from 1/40 h.p. at 1,350 r.p.m. as a shaded pole totally-enclosed still-air motor, up to ⅓ h.p. at 1,425 r.p.m. as a drip-proof split phase or capacitor motor. (*Crompton Parkinson Limited, Crompton House, Aldwych, London, W.C.2.*)

Valve positioner

The Fisher type 3560V/P valve positioner, is now in production by Fisher Governor Co. Ltd., a member of the Elliott-Automation Group. This is a new instrument designed to be accurate, fast and sensitive with low air consumption, and ease of adjustment. It has a break frequency at 5 per cent. of full instrument pressure range of 3.9 cycles per sec.

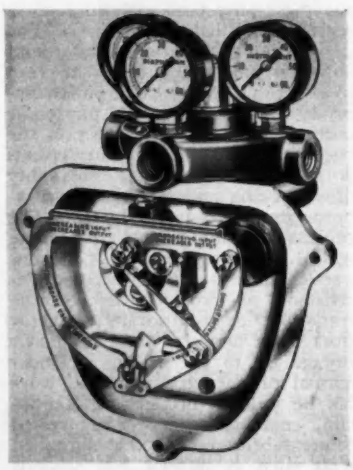
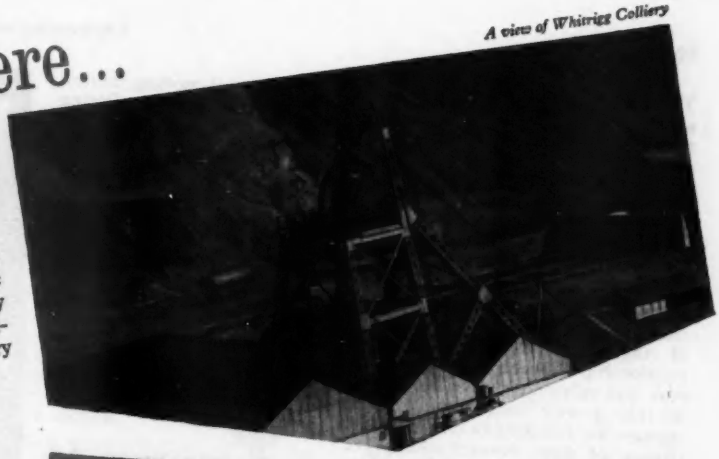


Fig. 7. Low air consumption valve positioner. (Fisher Governor Co. Ltd.)

Coal from here...

A tonnage equivalent to the entire output of a colliery will be consumed by the new British Motor Corporation factory now being erected at Bathgate in Scotland. The B.M.C. choose *coal* because coal has proved the most economical fuel for their purpose, because coal is home-produced and unaffected by policy changes abroad, and because our coal-fields can produce all the coal British industry will need for many generations to come.

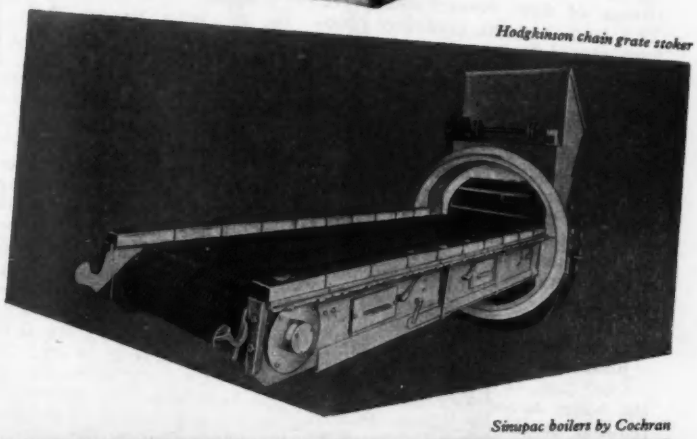
A view of Whitrigg Colliery



...will be fed...

Hodgkinson new design Mark V Chain Grate Stokers are being installed by B.M.C. for maximum thermal efficiency. These stokers maintain a flexible heat control, burn coal smokelessly and can cope rapidly with fluctuating loads.

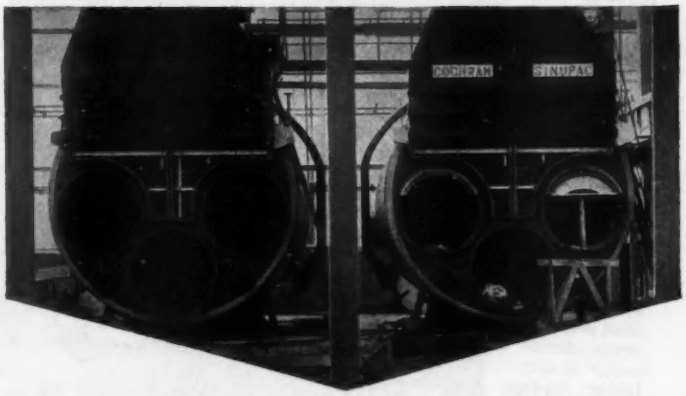
Hodgkinson chain grate stoker



...into these...

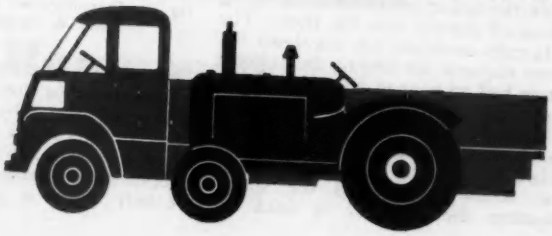
Five high-pressure automatically controlled, hot water Cochran 'Sinupac' boilers will each burn (per hour) 1.8 tons of untreated smalls containing 40 per cent fines. B.M.C. choose Cochran because, even with this low-grade coal, the efficiency will be approximately 80 per cent on the gross C.V. The total capacity of the five boilers is potentially 160,000,000 B.T.U.'s per hour. This will increase when the factory is in full production.

Sinupac boilers by Cochran



to power the factory that makes these...

The new B.M.C. factory—an important landmark in the industrial progress of Scotland—will produce approximately 400 tractors and 1,000 commercial vehicles a week, and will employ some 5,000 to 6,000 people. This new B.M.C. factory, burning British coal, automatically fired by Hodgkinson stokers in Cochran boilers, will increase Britain's prosperity at home—and British trade overseas.



BMC DRIVE AHEAD WITH COAL, HODGKINSON AND COCHRAN

This improved frequency response overcomes the disadvantage of using a diaphragm actuator in a process control loop. Where a typical time lag may have been 1 sec. or more, the type 3560, it is claimed, has reduced this to 0.03 sec. A feature is the use of interchangeable characterised cams to enable the control valve characteristic to be more closely matched to the process characteristic. Where a characterised cam is installed in place of the standard linear cam, the relationship between instrument pressure and valve plug travel is changed so that greater instrument pressure changes are required to create a given change of flow through the valve. This helps to solve instability problems caused by an oversized control valve. The Fisher 2560V/P can be converted from direct to reverse action or changed to split range operation by means of a few simple adjustments and without any additional parts. It can be mounted on any type of Fisher actuator yoke by means of mounting pads. Special mountings can also be provided for any other make of diaphragm actuator. (*Fisher Governor Co. Ltd., Rochester, Kent.*)

Auger conveyor improves boiler house efficiency

Coal dust, dirt, time and labour in the boiler house have been greatly reduced at T. D. Cross & Sons Limited, of Great Bar, Birmingham, by the use of a 23-ft. Mayrath auger conveyor supplied by Gordon Felber & Co. Ltd. It conveys coal directly from a lean-to coal shed outside the boiler-house to the loading hoppers next to the boilers. Previously, the coal was handled manually in wheelbarrows. During the autumn, winter and spring months, steam for heating the factory and for operating the automatic chromium-plating plant is raised in a Cochran boiler which is fired with washed Cannock nuts. Formerly, the coal was delivered to a shed away from the boiler house and hence carried in wheelbarrows to the boiler house. The loading of the boiler feeding hoppers by hand, entailed the work of several men, and considerable coal dust was produced. Now, the coal is conveyed directly to the hoppers from a covered shed outside the boiler house, the coal being dumped directly into this shed. The Mayrath conveyor has cut down the time required for loading the hoppers from half an hour to just over 2 min., and the dust nuisance has been eliminated. During the summer months, when the chromium-plating plant is operated by gas boilers and no steam is required for space-heating, the conveyor is used for various coal-moving duties, particularly in transferring the nuts from one pile to another to build up stocks for the September return to coal-firing of the boilers. The accompanying illustration (Fig. 8) shows the Senior Mayrath conveyor which passes through a hole in the boiler house wall to discharge into the loading hopper in the foreground. (*Gordon Felber & Co. Ltd., Spirella House, Oxford Circus, London, W.1.*)

Fig. 8. Senior Mayrath 23-ft. conveyor at works of T. D. Cross. (Gordon Felber & Co. Ltd.)

Steam trap

The "Dyna Trap," a new type of thermodynamic trap, which avoids the disadvantage of double seats common in most traps of this type, has been introduced by Lancaster & Tonge Ltd. The trap has only one main moving part, this being the piston. The valve consists of a stainless-steel ball, working on a stainless-steel seat, of orthodox design. Both valve and seat are replaceable without removing the trap from the line. The trap works by detecting the alteration in pressure which occurs in a passage in the trap when the flow of water changes to steam.

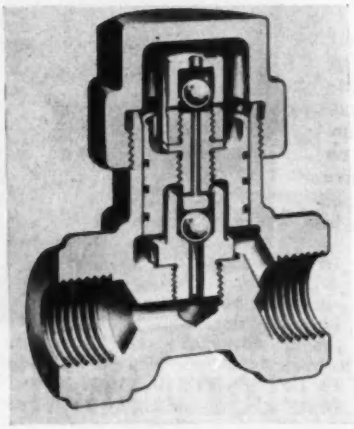


Fig. 9. Thermodynamic steam trap. (Lancaster & Tonge Limited.)

This change in pressure operates the piston, and thus closes the valve. The piston is operated by the steam in the trap and this steam condenses after a short period, allowing the valve to reopen and discharge any condensate. If only steam is present, the trap quickly recloses. The question of flash steam from the condensate, has also been taken into account in the design, which, it is claimed, is an unusually flexible one in which the characteristics, including the speed of closing of the valve, can be modified without difficulty. From the practical point of view, the use of a ball-valve will lead to little or no maintenance being required, but replacement of the valve and seating can be done quite easily. The trap is made entirely of stainless-steel. At present it is only available with $\frac{1}{2}$ in. B.S.P. inlet and outlet connections. (*Lancaster & Tonge Ltd., The Lancaster Works, Pendleton, Manchester 6.*)

Metering pumps

The model G/50 proportioning pump manufactured by E.C.D. Limited embodies a high degree of flexibility in layout, with a wide range of metering capacities and operating pressures. It incorporates a stroke adjustment mechanism which allows variation of pumping capacity manually, remotely or automatically, while the pump is running. The basic form of the pump consists of a motor, a drive unit and one or two liquid ends. By means of shaft extensions, additional pumps can be driven from the same prime mover, to meter a variety of liquids proportionally. Gear ratios are easily changed to accord with alterations in operating conditions. Features of the pump include:—an accuracy within ± 1.0 per cent. of maximum from the plunger pumps; the stroke adjustment knob is stationary when the pump is running; a wide range of stroking speeds and plunger diameters is available; changing of liquid ends is easily accomplished, and pump units may be ganged to increase capacity or to meter more

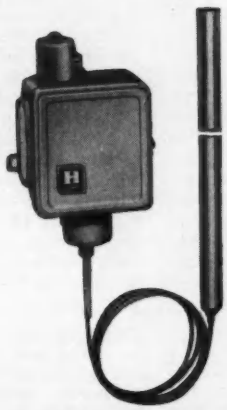
the fallacy

that you need *complicated* installations and expensive equipment to get the increased safety and efficiency of automatic control.

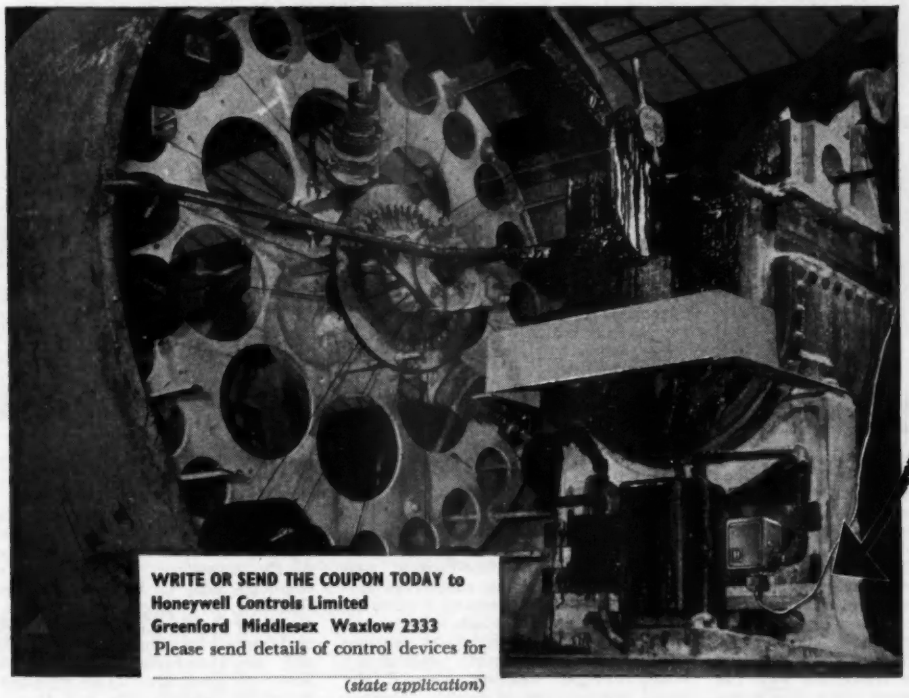
the picture

see the Honeywell control device in the lower right-hand corner. Under extremely dirty conditions it controls the temperature of the bitumen bath above it simply, accurately and automatically. For about the cost of a car battery, this process now operates with all the advantages of automatic control.

And temperature's not the whole story. There are similar Honeywell control devices for pressure, flow, differential pressure, humidity, liquid level. All are *inexpensive*, extremely *versatile*, and virtually *maintenance-free*. If you have still to investigate the possibilities of Honeywell control devices it would pay you to do so now.



this Picture puts paid to a popular fallacy



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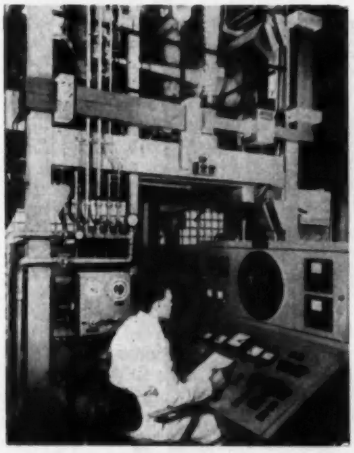
than one liquid. Alternative liquid ends are available, viz. plunger pumps, diaphragm pumps or piston diaphragm pumps. The design allows flexibility in layout, and up to 10 or more driving units can be powered from a single prime mover subject only to the limit of maximum power take-off. Automatic adjustment of pump stroke length may be made electrically or pneumatically. These modes of control make it possible to alter pump output according to other process variables, or in accordance with a preset programme. As an alternative, the stroke adjustment may be made from a position remote from the pump or manually. (*E.D.C. Limited, Tonbridge, Kent.*)

G.E.C. passout turbo-generator for paper mills

The General Electric Co. Ltd. recently received an order from the Reed Paper Group for a 5 MW passout geared turbo-generator and the associated condensing, plant valued at approximately £125,000. It will be installed alongside two existing G.E.C. sets in the Group's Empire Paper Mills at Greenhithe, Kent. Designed for inlet steam conditions of 600 lb./sq. in. and 800 deg. F., the turbine will exhaust to a vacuum of 28½ in Hg. The turbine will be fitted with a pressure-controlled passout for delivery of up to 80,000 lb./hr. of process steam at 20 lb./sq. in. gauge. The condensing plant will be manufactured by Hick Hargreaves & Co. Ltd. The layout of the two existing sets in the Empire Paper Mills is unusual in that the condensers are arranged axially with condenser tube withdrawal under the turbine, and air-cooler tube withdrawal under the exciter. This was done to avoid demolishing the robust concrete foundation blocks which were originally constructed for steam engines. The new 5 MW set is to replace an existing set and will be installed on the same foundations, with the condenser also arranged axially. It is of interest to note that in 1960 Reed Paper ordered a G.E.C. 7 MW backpressure set and a 10 MW passout condensing set for Aylesford. (*Engineering Group, General Electric Co. Ltd., Erith, Kent.*)

New Research Laboratories at Sandvik Steel Works

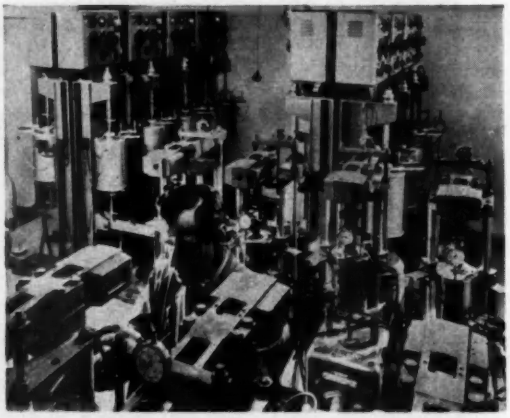
His Majesty the King of Sweden, formally inaugurated, on June 1st, the new steel research centre and laboratories of Sandvikens Jernverks AB (Sandvik Steel Works Co. Ltd.). The inauguration



took place in the presence of many representatives of research institutions and important industries. This major extension of the research facilities at the Sandvik Steel Works, which are located 120 miles north of Stockholm, has cost about seven million Swedish Kronor (£500,000). The company's steel research organisation employs more than 250 people and is the biggest in Sweden. For long-term research into metal physics and process metallurgy, there are two special laboratories concerned with the difficult, and often time-consuming development, of the "steels of tomorrow"; these laboratories have now been equipped with an extensive range of instruments and research plant of the most modern design. The physical metallurgy laboratory, housed in a new five-storey main building with a total floor area of about 35,000 sq. ft., contains a powerful electronic microscope capable of a magnification of 200,000. an X-ray machine, a high-temperature microscope, etc. The new pilot-plant for research into process metallurgy contains heavy equipment such as a high-vacuum melting-furnace for the production of extremely pure steel, high-frequency melting-furnaces, pelletising and reduction equipment, and laboratories for basic research into steel production methods and the reduction of ore. For research into steel production, there are two laboratories—one for tubes and bars, and the other for strip and wire. These laboratories are concerned mainly with the further development of the company's existing steel specialities.

(Left). Instrument panel of the high-vacuum electric arc furnace in which vacuum steel of the highest purity and homogeneity is produced at the Sandvik laboratories.

(Right). Battery of machines for the measurement of creep—or deformation as a function of time and stress—at high temperatures.

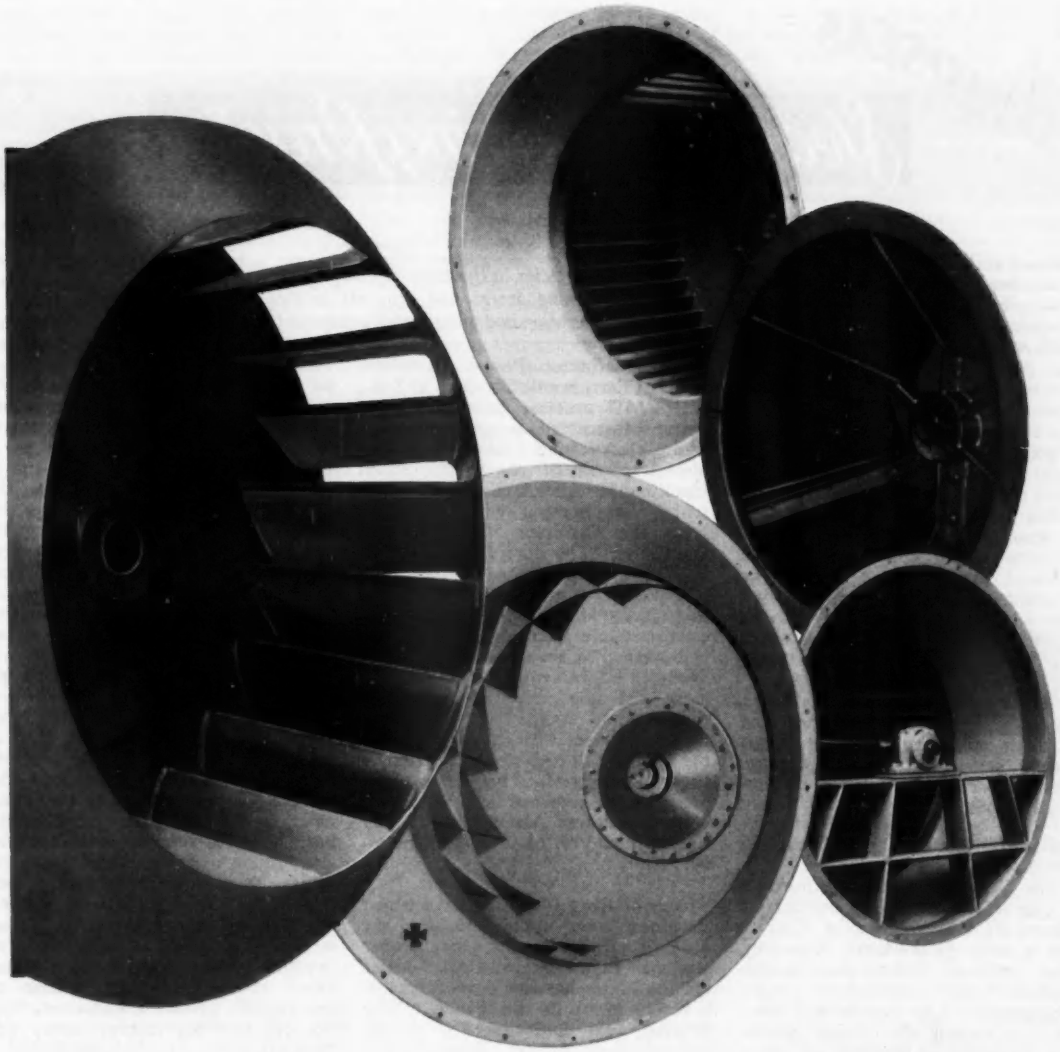


At the Clean Air Exhibition held at Brighton on October 4th to 6th, **Lodge-Cottrell Limited,** Birmingham, exhibited an animated display panel depicting the basic principle of electro-precipitation and also a schematic arrangement of a blast-furnace gas-cleaning installation in which the animation of the various features is achieved by a special process which obviates the use of travelling bubbles or flashing lights. Another model, representing boiler flue-gas cleaning, showed the actual precipitation of smoke. **Lodge-Cottrell Limited** is well equipped to carry out site and pilot tests to establish design conditions for gas cleaning plant. Being a member company of Simon Engineering Limited Group, it enjoys the considerable technical and laboratory resources of the group and can execute integrated contracts embodying the specialist activities of associated companies.

The Industrial Products Sales Division of the Goodyear Tyre & Rubber Co. (Great Britain) Ltd. announce the appointment of two marketing supervisors, **Mr. W. R. Quick** (Hose Products) and **Mr. H. F. Escott** (Belting Products). At the same time, two additional sales engineers, **Mr. C. Brown** and **Mr. P. Bedford,** have been appointed to the division's Southern and Northern offices at London (46, Holloway Road, N.7), and at Manchester (24, Broughton Street) respectively. The manager of the whole division is **Mr. J. T. Pearson.**

* * *

Mr. C. E. H. Eckersley has relinquished his executive duties as sales director of Davidson & Co. Ltd. of Belfast, but continues his association with the company as a member of the Board of Directors, and in a consultative capacity. **Mr. W. R. Magowan**—general sales manager—has been appointed sales director.



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OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Construction of sea water conversion plant

Westinghouse Electrical Corporation has begun the construction of a 1,000,000 gal. per day plant that will convert sea water to fresh water at Point Loma, near San Diego, California. Once in operation it will be the largest multi-stage flash evapororator plant in the U.S.A. Flash evaporation process to be used in the Point Loma plant will consist basically of spraying heated sea water under pressure into a chamber that is at a lower pressure and temperature. A portion of the water will flash into vapour and will then be condensed providing water that is nearly free of impurities. The remaining salty water will pass through a series of additional chambers where the flashing process will be repeated. At each additional stage the condensed, salt-free water will be piped off. (*Combustion*, Vol. 33, No. 2, August 1961, p. 48.)

Computer control system for Kentucky power plant

The Tennessee Valley Authority is to employ two digital computers to control its Paradise Station Units 1 and 2, near Drakesboro, Kentucky. The computers will be used in conjunction with combustion control equipments. The system will automatically control the turbine generators, sequence monitor of the steam generators and will sequence cold start, hot restart, normal shutdown or emergency shutdown of the units. In addition, the system will perform sensor scanning and alarm monitoring, data logging trend recording and performance calculations. The two units will produce a total of 1,300 MW of power, and will be the largest power generating installations in the U.S.A. The first unit is scheduled to begin operation in the Autumn of 1962; the second is scheduled for May, 1963. (*Combustion*, Vol. 33, No. 2, August 1961, p. 25.)

Three sources of power at one site

Electricity produced from water, coal and nuclear fuel in adjoining power stations will soon be the unique distinction of the Carolinas Virginia Nuclear Power Associates Inc. At Parr, South Carolina, U.S.A., a 17 MW nuclear power plant is being constructed alongside existing hydro-electric and coal-fired, steam-electric plants of the former South Carolina Electric & Gas Company, which has merged with others to form the Carolinas Virgina Power Associates. The nuclear plant which is due for completion in mid-1962, will contain a prototype reactor, the first of its kind installed in a U.S. nuclear power station. The reactor is described by the designers, Stone & Webster Engineering Corporation, as a pressure-tube type, fired by uranium dioxide, and cooled and moderated by heavy water. Steam produced by the reactor will be piped to the nearby thermal station which generates power for the area served by the four-company Power Associates. (*Power Engineering*, Vol. 65, No. 9, September, 1961, p. 81.)

Spray cooling for peak-load plant

One of the main objections to the use of spray ponds for power stations—that the evaporation losses are too high—has not proved true of a recent plant in the U.S.A. The Arsenal Hill Unit No. 5 of the Southwestern Electric Power Company—a peak-load plant—is believed to be the first central power station spray pond application for several years in that country. It is possible that a cooling tower might have been chosen had it not been for the economic savings and advantages of the spray equipment for this 100-MW non-reheat steam turbine installation. Steam conditions are 1,450 lb./sq. in., and 1,000 deg. F., and an exhaust pressure of 3½ in. Hg. abs. The spray system as now existing consists of an old spray pond installed in 1925 and a new spray pond which was installed at the same time as the No. 5 unit, designed to handle approximately 70,000 gal. of cooling water per min. The lake in which the spray equipment is located has a surface area of 37 acres and contains a storage capacity of 310 acre-ft., at its normal water elevation (160 ft.). Facilities are available for raw water to be pumped from the city water main, which will probably be necessary each summer during the operating period. The performance obtained from this cooling water system has been very satisfactory. A performance test was run on one of the hottest days last year, when the dry bulb temperature was 95 deg. F., the wet bulb temperature 80 deg. F., the circulating water inlet temperature 92.5 deg. F., and the wind velocity 5 m.p.h. The data collected during the hottest part of the afternoon, showed that the spray pond had a 17 deg. F. approach to the wet bulb temperature when the circulating water temperature to the sprays was 107.5 deg. F. Calculations made from this data indicate that 75 per cent. of the cooling effect could be credited to the sprays and the remainder to the surface evaporation from the cake. Over the period of June 1st-September 23rd, the total losses caused by evaporation drift amounted to 0.7 lb. cooling water per lb. of steam condensed, and although the spray pond will have to carry a greater heat load as the power plant is called upon to produce more power, cooling water losses are expected to remain at this figure. (*Power Engineering*, Vol. 65, No. 9, September, 1961, pp. 78-80.)

Separately-fired superheaters for nuclear-powered plant

A feature of the plant design and operation of the Indian Point nuclear steam-electric generating station (U.S.A.)—due to commence operation by the end of this year—is the installation of two Foster Wheeler separately oil-fired radiant-convection type superheaters. These twin units will superheat saturated steam at 450 deg. F. from the reactor to 1,000 deg. F. to increase the output of 163 MW from the reactor to a total gross plant output of 275 MW. Superheating will effect a reduction in plant cost. To be operated by the Consolidated Edison Company of New York, Indian Point is the first nuclear-powered steam-electric gener-

ating station in the U.S.A. to utilise separately-fired superheated steam. Each of the two superheater units is designed for 25-in. water positive pressure on the gas side and 500 lb./sq. in. on the steam side. Steam inlet conditions are 447 deg. F., 395 lb./sq. in.; steam outlet conditions are 1,000 deg. F., 360 lb./sq. in. The steam enters both sides of the inlet header at the front of the furnace and travels downwards in parallel paths in the front and roof-rear walls to the intermediate headers at the bottom front and rear of the unit. Approximately half the total steam in the front and rear walls goes to each side wall lower header, thence to the radiant outlet headers at the top. This steam mixes as it moves to transfer headers at the rear of the furnace and proceeds down the rear wall of the convection inlet header. Here, the steam rises through a multi-loop convection superheater to the outlet headers. Two headers are provided at the top to accept steam from alternative loop elements and each is connected to a common mixing chamber en route to the turbine. Thus the steam in each superheater is internally mixed several times and is ultimately mixed together before it goes to the turbine. All the heat-absorbing tube elements in the superheaters are of alloy steel with the wall thicknesses based on a conservative estimate of the metal temperature. Each superheater is arranged at present to be fired by eight steam atomising oil guns in F.W. intervane burners. The burners are in individual boxes and designed with provision for future coal firing. They have a high turn-down ratio and each box has its own air outlet control damper. With this arrangement, the most complete combustion is assured and optimum flame control is available. Each main burner has an air atomising light oil ignitor. Although properly sized for ignition service, by changing the tips and plugs, the ignitors are capable of furnishing sufficient heat to safely raise 100,000 cu. ft./min. of ambient air to 300 deg. F. (as required for stack purging) with no steam flowing in the elements. Final steam temperature control is primarily by varying the fuel and air input, temperature sensing elements being located in the two steam outlet pipes. To reduce time lag in the control system, an anticipating element has been added, which will sense changes in steam load by monitoring the rate of change in pressure drop across the superheater. Except for safety devices, the fuel-air input is the main temperature control. (*Heat Engineering*, Vol. 36, No. 4, July-August, 1961, pp. 55-57.)

The second large order for irrigation pumping machinery in British Guiana to have been received within the last three years, is announced by **Gwynnes Pumps Limited,** Hammersmith and Lincoln (an associate company of **W. H. Allen Sons & Co. Ltd.,** Bedford). Valued at £31,540, the contract has been received from the main contractors, Pauling & Co. Ltd., on behalf of the Government of British Guiana (Department of Drainage and Irrigation) and is for the Tapakuma Irrigation Project. It covers the manufacture, delivery to site in British Guiana and the complete erection of two 42 in. vertical-spindle, axial-flow pumps complete with syphon discharges. Each pump is driven through bevel gears by Ruston & Hornsby five-cylinder diesel engines, each of which develops 276 b.h.p. Sir William Halcrow & Partners are the consulting engineers.

* * *

Orders totalling £54,000 for electric motors for use in a steelworks extension scheme in Turkey and a British refinery are announced by **Associated Electrical Industries Limited.** The motors will be supplied by the company's Motor & Control Gear Division. Burla Biraderler of Istanbul has placed a £24,000 order for both a.c. and d.c. electronic motors. They are to form part of the extension scheme at Karabuk Steelworks. Flame-proof high-speed electric motors worth £30,000 have been ordered for the new B.P. California Aromatics Plant being built at the British Petroleum Company's Kent oil refinery.

* * *

Birwelco Limited, Aston, Birmingham, has made an agreement with Yuba Consolidated Industries Incorporated, of Tulsa, Oklahoma, to manufacture and sell Aimco Transaire air-cooled heat-exchangers in Europe and the British Commonwealth. Birwelco has already received several large contracts for this type of equipment from both the oil and chemical industries. Transaire air-cooled heat-exchangers incorporate finned tubes and electrically-driven fans, and are designed specifically for the oil-refining, petrochemicals and chemical-processing industries. They are particularly useful in areas where the water supply is inadequate or unreliable. The tubes and the fins, which are wound spirally on the tubes without brazing or welding by a special mechanical process, can be of mild steel, stainless-steel, brass, copper or aluminium, according to the ambient atmosphere and type of liquid to be cooled.

* * *

In keeping abreast of modern practices and techniques, the Instrument Division of **Evershed and Vignoles Ltd.** has made a number of important changes in its structure. Under the control of divisional manager, **Mr. H. A. Challinor,** the range of "Megger" products has been streamlined to permit greater concentration on more important and popular instruments and a number of new instruments are being planned and developed for production in the future. Changes in administration and personnel have been made to ensure even closer and better customer contact than before. In charge of Home Sales is **Mr. R. M. Wardrop,** who was previously Scottish Area Manager.

* * *

Since the City and Guilds Boiler Operator's Certificate course was launched in 1952, 1,081 employees of the **National Coal Board** have gained their boiler operator's certificate. This means more efficient use of coal in the Board's own colliery boiler plants. Training for the examination takes seven months, and is so arranged that men on shift work can take full advantage of it. Students work on a home study course arranged by the N.C.B. through the College of Fuel Technology, and meet in groups once a month under the chairmanship of one of the Board's fuel engineers to spend a day in revision and doing practical work. Successful candidates can take courses for more advanced examinations, up to and including the City and Guilds Combustion Engineering (Advanced) Certificate.

Edwin Danks & Co. (Oldbury) Ltd., a subsidiary company of Babcock & Wilcox Limited, has secured in collaboration with two well-known American design organisations, the main contract for the supply of a gasoline plant and associated well-head equipment for Tehnometal Export-Import, Yugoslavia, which is acting on behalf of the Naftagas concern in that country. The plant is to produce gasoline and industrial gases from the natural gas which is found in parts of Yugoslavia. The total value of this contract is more than £1 million and the majority of the material will be supplied from United Kingdom sources, representing a valuable contribution to the expansion of this country's exports.

* * *

Water-treatment plant and equipment designed by **William Boby and Co. Ltd.** is to be produced and marketed in Australia under an agreement with the **Magnus Chemical Co. (Pty.) Ltd.** of Victoria. The concession applies to the whole range of Boby plant except where electrodialytic methods are involved. This is the second agreement of its kind that William Boby & Co. Ltd. has reached with an overseas company this year. A South African firm—**Watermasters (Pty.) Limited,** has already begun production of Boby plant. The managing director of the Hertfordshire company, Mr. Michael Boby, says: "Since we do not manufacture the equipment we design, it has long been realised that it is far more practicable to export techniques. We have, in fact, installed plant in about 25 countries—including Australia and New Zealand—but the Magnus Chemical Co., with all its facilities for production, sales and maintenance, is nonetheless in a far better position to serve local markets."

* * *

A handy reference guide to their range of products has been produced by **Rockweld Limited,** Commerce Way, Croydon. It is a folder giving details of their arc-welding equipment, including electrodes, welding plant and accessories.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Nuclear power plant

In nuclear fission plants it is necessary to maintain definite temperatures in the surroundings of the fission materials such as uranium and plutonium, and for this purpose various cooling materials such as heavy water, gases under pressure, liquid sodium and liquid sodium alloys and other liquid metals have been used. These coolants have been found to be undesirable due to the conditions at which they must be handled, and recently the inventor overcame this difficulty by employing a mass of circulating granular solid material which at the same time serves as a moderator for the nuclear reactor but does not absorb neutrons, only slowing them down. An important object of the present invention is the provision of means for facilitating the cooling of a nuclear reactor by granular solid material, and in particular to afford intimate contact between the solid granular coolant and the nuclear reactor for the purpose of cooling and moderating the reactor while transferring heat from the reactor to a heat-exchanger. According to the invention, a rotatable container of an atomic power plant contains a stationary nuclear reactor and a stationary heat exchanger, a granular cooling agent being provided in the container which during rotation of the container is urged around between the reactor and the heat-exchanger. Referring to Fig. 1, numeral (10) designates a housing such as concrete. The housing (10) may be suitably shielded with any desirable material such as lead or water for absorbing any stray radiation. Rotatably mounted within the housing (10) is a container or casing (12) constructed of suitable material such as metal, and having an opening (14) preferably in its centre, controlled by an automatic valve (16). A tubular shaft (18) having a central axis (20) is connected to the casing (12) for allowing material falling through the valve (16) to be delivered by gravity through it. A motor (22) which is preferably suitably shielded from radiation is provided for rotating the casing (12) about its longitudinal axis which is vertical and, as desired, the tubular shaft (18). The casing may be rotated in the direction as indicated by the arrow at (24). Fixed within the housing (10) so as to be stationary with respect to it, is a nuclear reactor (26) of conventional construction. It is noted that the reactor (26) is offset from the axis (20). A heat-exchanger (28) having a series of tubes for cooling fluid, such as water, is also disposed within the casing (12) and as shown oppositely disposed from the reactor (26) and offset from the axis (20). The heat-exchanger (28) connected through pipes (30) to lead steam or heated fluid in the direction of arrow (32) to a consumer device, such as steam turbine or

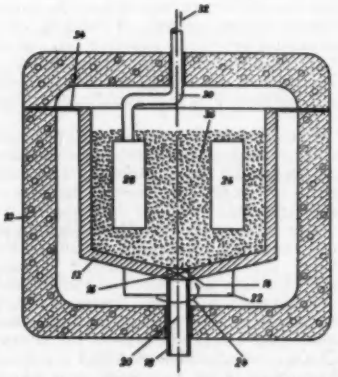


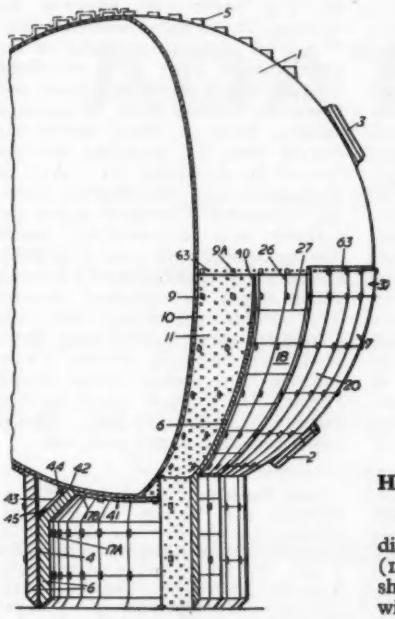
Fig. 1. British Patent No. 875,872.

suchlike. The casing (12) may be supported as at (34) by bearing plates or the like, or otherwise mounted within the housing (10), and provided in the latter is means for supplying granular cooling material, preferably by gravity, to the interior of the casing (12). This granular cooling material (36) is selected from the group including graphite. This granular cooling material (36) is disposed within the casing (12) and is in intimate contact with the reactor (26) and the heat-exchanger (28). The granular cooling material such as graphite will, therefore, serve to moderate and cool the reactor (26) while not absorbing neutrons. The heated granular cooling material will supply heat to the heat-exchanger (28). Thus, upon operation of the motor (22), the casing (12) will rotate, directing material which has been heated by the reactor (26) into intimate contact with the heat-exchanger (28). The motor (22) may be operated intermittently even though the power plant is in continuous operation. Further, the granular cooling material may be supplied on a continuous basis with the operation of the valve (16) being automatic or being operated on a timed sequence so as to deliver the granular material through the tube (18) to another location which may be remote from the reactor (26) while it may supply heat to a heat-exchanger. *British Patent No.* 875,872 *issued to F. A. Henglein. Complete specification published August 23rd,* 1961.

Pressure vessel for nuclear reactor

This invention relates to pressure-vessels adapted to contain hot fluids under pressure and in particular to pressure-vessels provided externally with thermal insulation. Thermal insulation may be applied to a pressure-vessel simply to reduce heat losses or, as in the case of a nuclear reactor pressure-vessel, an object of the insulation may be to limit temperature gradients and resultant thermal stresses in the pressure-vessel wall. The pressure-vessel enclosing the core of a gas-cooled heterogeneous nuclear reactor may be of very large size, and the application of effective insulation to the vessel in an economical manner is an objective of importance. A difficulty arises from the substantial expansion of the vessel when brought into use, and there is the necessity of accommodating the expansion both by the insulation and by cleaning with which the insulation is desirably covered. To satisfy the requirements of effectiveness and economy, the cleading must be formed of panels which are economical to construct and install, and which are capable of accommodating the relative thermal expansions and contractions of the pressure-vessel. The provision of inexpensive cleading tends to be more difficult when the pressure vessel is of spherical shape. The cleading provided in accordance with this invention is formed of flexible sheet metal panels arranged

with the adjacent edges of neighbouring panels overlapping one another and connected by means holding together the edges in such a manner as to permit relative lateral movements of the panels. The panels are provided with lugs for this purpose. In Fig. 2 a

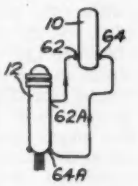


spherical pressure vessel (1) encloses a gas-cooled graphite-moderated heterogeneous nuclear reactor (not shown). The vessel is of about 70 ft. dia. and is provided with four gas inlets (2) and four gas outlets (3) arranged uniformly around it and through which the coolant gas flows. The pressure vessel (1) is provided at its upper end with charge-tube nozzles (5) and rests upon a cylindrical steel skirt (4). The inner and outer surfaces of the skirt (4) and the lower-half of the pressure-vessel (1) are thermally insulated from the surrounding air by a double layer of insulation (6) covered by cleading (7). The cleading is necessary to hold the insulation in place in the event of it breaking up, because the pressure-vessel is not accessible for maintenance while in use. At approximately the equator of the pressure-vessel the insulating layer (6) is tapered as at (40). The surfaces of the pressure vessel (1) and the skirt (4) are provided with rows of radially extending projections in the form of anchor plates (9), tie rods (10), and studs (11) which are flash-welded in position. The anchor plates (9) lie in vertical planes which contain the diameter of the pressure-vessel (1) and which are spaced at equal angles and arranged in horizontal rows. The tie rods (10) have their outer-end portions threaded and are indicated in Fig. 2 by crosses, while the studs (11) have their outer-end portions split longitudinally and are indicated by dots. The double insulation layer (6) comprises an inner layer of high-temperature insulation and an outer layer of low-temperature insulation. The inner and outer layers of insulation are each formed from a single layer of flat slabs of insulating material known as 85 per cent. magnesia, each slab being of rectangular shape 36 in. long and 6 in. wide. *British Patent No.* 875,868 *issued to Babcock & Wilcox Limited. Complete specification published August 23rd,* 1961.

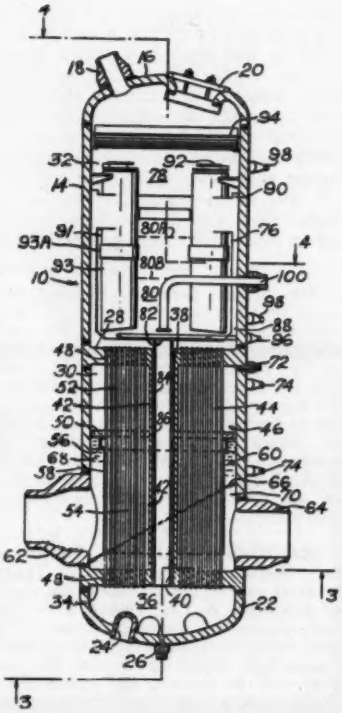
Fig. 2 (left). British Patent No. 875,868.

Heat exchanger for boiling water reactor

In Fig. 3, a steam generator (10) is disposed above a boiling water reactor (12). The steam generator (10) as shown in Fig. 4 is arranged to operate with a normal primary water-level (50) in the steam generating section (30) above the support ring (56), so that primary water flows downwardly within the shroud (58), and a body (54) of primary water is maintained, filling the space within the shroud (58). The steam generating unit (10) is also arranged to operate with a normal secondary water-level in the steam-separating section (32) within the baffle (76) above the aperture (82). In operation, primary steam/water mixture heated in the core leaves the boiling-water reactor (12), as described in connection with Fig. 3, and enters the steam generating unit (10) through the inlet (62). The steam-water mixture is directed upwardly by the baffle (66) through the inlet portion (68) of the flow passage (69), and some degree of separation is effected in the region of the normal water-level (50), with the primary steam rising upwardly into the steam space (52), above the water-level (50) and below the tube-plate (28). The primary water flows over the top of support-ring (56) and downwards over lower parts of the steam-generating tubes (44), the downflow of water being confined in its flow path by the tube shroud (58). In the steam space (52), the primary steam is condensed as it flows in indirect heat transfer relationship with the secondary water flowing upwardly through upper parts of steam generating tubes (44). The condensed primary steam mixes with the primary water and flows downwardly with it within the confines of the tube shroud (58) and



Figs. 3 (right) and 4 (below). British Patent No. 876,308.



is in indirect heat transfer relationship with the secondary water in the lower parts of the steam generating tubes (44). After its passage downwardly through the shroud (58), the primary water flows out under the shroud into the outlet portion (70) of the flow passage (60) and is discharged from the vapour generating unit through the outlet (64). It will be appreciated that in the course of flowing over the steam generating tubes below the normal primary water-level (50), the primary water is suitably cooled to a desired temperature below saturation temperature before it leaves the pressure-vessel (14). As can be seen in Fig. 3, the cooled primary water from the outlet

(64) flows to the reactor (12) entering at inlet connection (64A) to complete its closed cycle passage through the reactor (12) and the steam generator. Secondary water which is to be vaporised within the steam generating section (30) flows downwards from water-space (80) within the baffle (76) through the downcomer (84) to the secondary water inlet chamber (36). To avoid generating steam in the downcomer (84), which would interfere with the natural circulation of the secondary water in the steam generating unit, a small amount of secondary water is naturally circulated upwards through the annular flow path (86) between the downcomer (84) and the sleeve (42). In addition to avoiding vapour generation in the secondary water downcomer, the interposition of the secondary water in the annular flow path (86) protects the sleeve (42) from thermal shock due to difference in temperatures between the primary steam and water flowing on one side of the sleeve (42) and secondary water flowing in the downcomer (84). From the inlet chamber (36) below tube-plate (34), the main body of secondary water flows upwardly through the steam-generating tubes (44) in counterflow and in direct heat transfer relationship with the primary water flowing downwardly within the shroud (58) and with the steam in the steam generating space (30) above the liquid level (50). Steam is generated in the secondary water as it passes first upwards through the body of primary water (54) within the shroud (58) and then upwards through the steam space (52). The secondary steam-water mixture enters the rise passageway (88) from the tubes (44) and flows upwardly therethrough into the steam separators (91). The separators (91) serve for the separation of the secondary steam and water, and separated secondary-steam flows upwardly from the tops of the separators (91) through the corrugated plate steam scrubber (94) where substantially all of the entrained moisture is removed, and finally through the outlet (18) to a point of use (not shown). Separated secondary water is discharged downwardly through the extension sections (93) of the separators (91) and flows into the water space (80), being directed inwards across the bottom of the container towards the opening (82) to the downcomer (84). Feedwater is supplied to the secondary steam generating system through the conduit (100) which discharges within the cup baffle (76) adjacent the opening (82) to the downcomer (84). The level of secondary water in the water-space (80) is maintained between a high water-level (80A) and a low water-level (80B) to assure a suitable head of water above the outlets from the extension sections (93) of the separators (91). As it is discharged from the conduit (100), the secondary feedwater mixes intimately with the secondary water flowing inwardly from the separators, and serves to condense steam bubbles which might be entrained therein. This assures substantially steam-free secondary water in the water space (80), and facilitates natural circulation in the secondary circuit. *British Patent No.* 876,308 *issued to The Babcock & Wilcox Company. Specification published August* 30*th*, 1961.

Sir Willis Jackson, F.R.S., who since 1953 has been director of Research and Education of Associated Electrical Industries (Manchester) Limited (formerly Metropolitan-Vickers Electrical Co. Ltd.), relinquished his appointment on September 30th to return to academic life as professor of Electrical Engineering at Imperial College, University of London. **Dr. J. M. Dodds,** O.B.E., M.A., B.Sc., has been appointed director of the A.E.I. Research Laboratory, Manchester.

* * *

Mr. Niall Macpherson, Parliamentary Secretary to the Board of Trade, recently paid an official visit to the works of **Cochran & Co. Annan Ltd.**—the well-known boiler manufacturers. The visit was a direct result of the Company's tremendous export drive over the past year, and the Minister has expressed his desire to personally thank the Company and its employees for all their efforts. At the works, the Minister was greeted by **Mr. R. B. Lamb,** joint managing director of Cochran's, and was afterwards taken on a conducted tour of the works. It is of interest to note that the company export more than one-third of their total annual production of boilers and pressure-vessels to world markets—a very high figure for this particular industry.

* * *

Cambridge Instrument Co. Ltd. have recently published a series of leaflets detailing ranges of instruments made at the Mechanical Thermometer Division, and now available from stock. These include dial-type thermometers with vapour-pressure and mercury-in-steel systems, temperature regulators, draught and pressure indicators and recorders, and humidity instruments.

At the Dungeness Nuclear Power Station of the C.E.G.B., the h.p. and l.p. boiler feed pumps will be driven by six 2,000 h.p., and six 1,625 h.p., 2,960 r.p.m. squirrel-cage motors ordered from **A.E.I. Limited** by the **Harland Engineering Co. Ltd.,** the pump makers. The four circulating-water pumps will be supplied by **Drysdale & Co. Ltd.,** who have ordered four 1,625 h.p., 965 r.p.m. squirrel-cage induction motors and gearboxes from A.E.I. for this duty. Motors previously used for this class of duty at other nuclear power stations have been 250 r.p.m. direct-coupled machines, and this is the first order for 965 r.p.m. geared motors, which are, of course, smaller and less costly than 250 r.p.m. machines of the same rating. In addition to the above mentioned motors for Dungeness, A.E.I. will supply 35 new type multi-motor control centres for the control of pumps, fans and valve motors for the reactor auxiliary equipment, reactor gas-turbines, boilers, steam-turbines and water-treatment and decontamination plant.

* * *

Mr. Leonard H. Short, M.C. (director of Overseas Operations, The English Electric Co. Ltd.), has been elected chairman of the Export Panel of the British Electrical and Allied Manufacturers' Association. The panel, comprising leading specialists in the electrical industry on export matters, is the chief advisory body to the BEAMA Council on overseas trade. Mr. Short has been vice-chairman of the panel for the past two years, and succeeds **Mr. E. V. Small** (consultant to Associated Electrical Industries Export Ltd.) who has been chairman for this period. The new vice-chairman is **Mr. Harold P. Martin** (sales director, C. A. Parsons & Co. Ltd.).

Jost Prescher, director of K.F.A. Limited, and Werner Marcinkowski, official representatives in the United Kingdom of the Chamber of Foreign Trade of the German Democratic Republic, visited the Cheadle Heath, Stockport, headquarters of **Simon-Carves Limited** on Thursday, October 5th, 1961. The visitors were particularly interested in the capacity of the company for contracting for the building of a projected complete polyethylene plant at Leuna. They were welcomed by **Mr. T. Kennaway,** director of Research, who conducted them on a tour of Simon-Carves research departments.

* * *

A contract worth about £300,000 for the major part of the electrical equipment in a new pulp and paper-mill to be built in Yugoslavia has been awarded to **The English Electric Co. Ltd.** by Millspaugh-Wimpey Limited. The equipment, consisting of power distribution gear and motors for driving the process machinery, will be made at Stafford, Liverpool and Bradford and delivered by mid-1963. The new mill, at Plaski in Croatia, will be operated by Tvornica Sulfatne Celuloze y Papira. English Electric will supply a 35,000 volt outdoor substation consisting of three oil circuit breakers and a 10-MVA transformer to step power down to 10,000 volts. Power will be distributed by the main switchboard and some 21 substations and transformers in the factory. Variable-speed drives for the process machinery include one of 850 h.p. for the paper machine (designed to produce 100 metric tons of sack kraft and kraft liner a day), one of 80 h.p. for the pulp machine and one of 105 h.p. for the rewinder. There will be some 380 constant-speed a.c. motors.

Announcing

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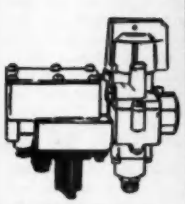
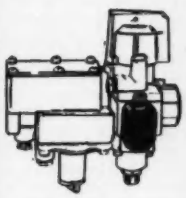
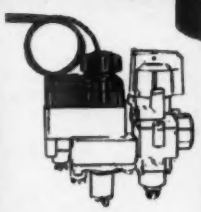


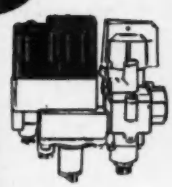
Gas governor screws into bottom.



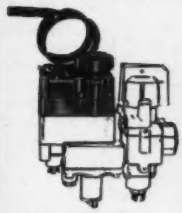
Pilot gas fitter cartridge slips straight into the top of the manifold.



Add on two-position thermostat (T5000) for temperature control.



Add on *24 volt electric operator* to use Honeywell's line or low voltage room thermostats and Aquastat boiler controls.



Add on Modusnap thermostat (T5001) for modulated control from 'high Flame' to 'minimum flame' and snap to 'off' position.

WRITE OR SEND THE COUPON TODAY to
Honeywell Controls Limited
Greenford, Middlesex. Waxlow 2333

I am interested in your new ADATROL gas fired heating controls.
Please send me—
Your leaflet
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Your booklet
'Make the most of Gas Heat Comfort' ☐

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POSITION .....

COMPANY .....

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Sales Offices in the principal towns and cities in the United Kingdom and throughout the world.

- **saves time and money**—just a few turns of a Phillips screwdriver and you've added on a new control feature or removed a part for servicing . . . without disturbing the piping.
- **saves space**—needs less room on the boiler or warm air furnace . . . simplifies inventory.
- **saves gas**—used in conjunction with new Honeywell gas pilots which drastically cut pilot gas consumption.
- **secures comfort**—provides an ideal control point for low voltage room thermostats . . . simplest to instal for greatest comfort with whole house heating.

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First in Control

SINCE 1885

NOTES *Personal* AND *Industrial*

The Minister of Power has appointed **Mr. A. Bond,** L.M.T.P.I., Companion I.E.E., to be chairman of the Yorkshire Electricity Board in succession to Mr. D. Bellamy, C.B.E., D.L., F.A.C.C.A., etc., who retires on February 24th, 1962, after serving as chairman of the Board since February, 1952. Mr. R. H. M. Barkham, B.Sc.(Eng.), M.I.E.E., is to succeed Mr. Bond as deputy chairman of the Board. Mr. Bond has been deputy chairman of the Yorkshire Electricity Board since February 1st, 1952. A solicitor and former Town Clerk of Macclesfield and Stockport, he was secretary and solicitor of the Eastern Electricity Board from 1948 until 1952.

* * *

Babcock & Wilcox Limited announce that **Sir Eric Mieville,** G.C.I.E., K.C.V.O., C.M.G., is retiring from the chairmanship of Dewrance & Co. Ltd. on December 31st, 1961. The present deputy chairman, **Sir Donald Perrott,** K.B.E., will succeed Sir Eric Mieville as chairman. **Mr. J. B. W. Cunningham** has been appointed managing director, and will take up duty towards the end of January. Mr. Cunningham is at present managing director of the Engineering Group of the United Kingdom Atomic Energy Authority.

* * *

Mr. J. M. Drummond, F.S.A.A., F.I.M.T.A., chief financial officer to the Central Electricity Generating Board, has been appointed financial adviser to the Electricity Council. Mr. Drummond will take over his new duties on December 1st, 1961, and will succeed **Mr. A. M. Scott,** M.C., C.A., the present financial adviser to the Council, who retires on November 30th.

* * *

Elliott Brothers (London) Limited, a member of the Elliott-Automation Group, announces that **Mr. A. C. Jones,** A.M.I.Mech.E., A.M.Inst.Fuel, has been appointed an assistant general manager within the Automatic Control Valves Group. Mr. Jones spent several years in the United States, training with leading American companies in the control and instrumentation field. He subsequently occupied various managerial positions within the Babcock and Wilcox Group, mainly in connection with sales and export activities. Before joining Elliotts, he was manager of the Audco Controls Division of Audley Engineering Co. Ltd.

* * *

The Council of British Manufacturers of Petroleum Equipment have appointed **Mr. R. A. Pittman,** B.Com., F.C.I.S., as deputy director, a new position which the Council's increasing membership and activities has rendered necessary. Mr. Pittman joins the Council after 14 years service with the British Engineers' Association, as its secretary since 1956, being previously economic adviser to the Research Department.

Mr. Sidney H. Ireland, B.Sc., B.Com., has been appointed managing director of Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6, in succession to **Mr. Norman Readman,** who becomes chairman of the Board. Mr. Ireland, who was for some years general manager of the Birmingham Small Arms Co. Ltd., joined Consolidated Pneumatic at the beginning of 1960 as assistant managing director.

* * *

Mr. F. L. Griffiths, M.Inst.F., M.I.Plant E., has relinquished his post as works engineer of the Fraser and Chalmers Engineering Works of the General Electric Co. Ltd. at Erith, upon his appointment as constructional engineer for the whole of the G.E.C. organisation. He is replacing Mr. R. Bennett, who has retired from the company's service, and from September 1st he can be located at Wembley. His successor as works engineer at Erith is Mr. H. B. Pellatt.

* * *

Mr. L. H. Welch, O.B.E., B.Sc.(Eng.), M.I.E.E., who retired recently from the position of chief electrical engineer to the London Electricity Board, has been appointed as industrial relations consultant to the Electrical Research Association.

* * *

Mr. Desmond Ambrose, who was until recently, manager of the Process Control Division of Constructors John Brown Limited, has been appointed manager of the Southern Division of Fischer & Porter Limited, manufacturers of flowmeters and process control instruments. Mr. Ambrose will operate from the Southern Sales Offices of Fischer & Porter Limited at 205, Station Road, Harrow, Middlesex.

* * *

Associated Electrical Industries Limited have appointed **Mr. W. S. Perkins,** A.C.G.I., A.M.I.E.E., as divisional executive (Rugby) of the AEI Transformer Division.

* * *

The National Coal Board have appointed **Mr. John Brass,** B.Sc. (Hons.), at present production director of their Northern (N. & C.) Division to be chairman of their West Midlands Division.

* * *

It is with regret that we record the death, which occurred in Italy recently, of **Mr. C. M. Vignoles,** C.B.E. Mr. Vignoles, who was 60, was a director of Evershed & Vignoles Limited, and since June last, chairman of the company of which his father, Lieut.-Col. W. A. Vignoles, was a former managing director. Mr. C. M. Vignoles was associated for many years with the oil industry, becoming managing director of Shell-Mex & B.P. Limited, a position which he held for 10 years until his retirement this year.

Mr. G. W. Giffin, M.B.E., F.B.I.M., director of manufacture on the Board of Associated Electrical Industries (Woolwich) Limited, retired at the end of September after a 22-year association with the Woolwich company.

* * *

Mr. J. N. Williams, M.Inst.C.E., M.I.Mech.E., F.Inst.F., retired from the technical department of Wm. Cory & Son Limited on September 30th last.

* * *

Dr. D. F. Denny, Ph.D.(Eng.), B.Sc.(Eng.), A.M.I.Mech.E., has recently been appointed chief engineer of Ronald Trist & Co. Ltd., Slough.

* * *

Mr. R. S. Medlock, A.R.I.C., A.M.I.E.E., A.M.I.Mech.E., engineering director, and **Mr. R. V. May,** mechanical meter marketing executive, of George Kent Limited, recently paid visits to South Africa and South America, respectively. Their individual missions, though geographically divorced, were both related to a policy of maintaining close personal liaison between parent company and overseas representation.

* * *

Wallace & Tiernan Limited, Chiswick, have issued a new publication (No. S/109) which gives briefly, information on a selected number of the chemical control units manufactured by the company, and also serves to indicate the numerous industries where their equipment is employed. Copies of the publication are available on request to the company at Power Road, London, W.4.

* * *

Henry Sykes Limited, Southwark Street, London, S.E.1, have appointed Land Development Corporation as agents for their pumps and other equipment, in Scotland and the four Northern counties. There will be three main Service Centres—Glasgow, Fife and Newcastle, and Mr. A. K. G. Gilbertson, A.M.Inst.C.E., who is located at the Fife depot, is responsible for the overall operation of the Agency.

* * *

British Boiler Accessories Limited, 62-3, Fenchurch Street, London, E.C.3, states that it is to manufacture the Stork de-aerator under licence in the United Kingdom.

* * *

An agreement has been signed between **Research and Control Instruments Limited,** Kings Cross, London, W.C.1, and **Sonatest Limited,** London, W.C.1, to the effect that marketing in the United Kingdom of Sonatest Ultrasonic non-destructive testing equipment will be carried out exclusively by Research and Control Instruments Limited. With the addition of Sonatest's equipment, technical knowledge and experience of ultrasonic flaw-detection, R.C.I.'s scope now extends over a wide range of applications for non-destructive testing.